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THE VALUATION OF URBAN REALTY FOR PURPOSES OF TAXATION

WITH CERTAIN SECTIONS ESPECIALLY APPLICABLE TO WISCONSIN

BY

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CHAPTER I

THE FUNDAMENTAL PRINCIPLES OF LAND VALUATION

A. Lands in General

In the valuation of land, just as in the case of other commodities, we must bear in mind that there are several different kinds of value to be taken into consideration.

The *subjective* value of a piece of land depends either on its direct utility to the owner or the utility of the commodities which he hopes to obtain in exchange therefor. The old family homestead may be worth $5,000 to its occupant though equally good houses in equally good locations may be purchased on the open market for $3,000. The $2,000 difference represents, in this case, a measure of the sentimental attachment which the possessor feels for the family home. Again, a residence may be more valuable to the owner than to any other person because its location is especially convenient to his place of business, or because of some peculiarity of the site or view which appeals especially to his particular taste. This kind of subjective value is, then, the "value in use" described by the earlier economists.

Another kind of subjective value which real estate, like other commodities, may possess is *subjective exchange value.* This differs from use value in that it does not depend upon the services which the commodity may render to the owner or to

the prospective buyer, but only upon what the purchaser is willing to give or the owner believes he will be able to obtain in exchange therefor. This, then, is based essentially upon speculation or estimates rather than upon direct utility to the possessor. Like use value it is largely psychological but, on the other hand, it is also largely dependent upon market conditions. Thus, the owner of a suburban lot may refuse to sell it for less than $1,000 though he can find no purchaser willing to offer him more than $700. He continues to hold the property because he believes that the demand for this class of suburban lots will, in the reasonably near future, increase to such an extent as to cause purchasers to be willing to pay $1,000 plus interest on that sum for the elapsed interval. The subjective exchange value placed on the lot by the owner is, then, often far above the market price but seldom falls much below it for any considerable time, since, in this event, buyers will be attracted and a sale is almost certain to take place.

This leads us to the consideration of *objective exchange value,* or, as it is more commonly designated, simply *exchange value.* Objective exchange value is merely a resultant of a number of subjective exchange values. If, at an auction attended by land speculators, there is only one piece of land for sale and many prospective purchasers the price at which the sale takes place will be higher than the subjective exchange value of the seller, lower than the subjective exchange value of the highest bidder, and higher than the subjective exchange value of the second highest bidder. The exact points between the last two limits at which the sale will be consummated will depend on the comparative bargaining skills of the seller and the highest bidder.

If, on the other hand, there are many similar pieces of land for sale and only one prospective purchaser for a single piece, the sale, if effected, must be at a price lower than the subjective exchange value of the would-be buyer, higher than the subjective exchange value of the man most anxious to sell, and lower than the subjective exchange value of the next competing seller, the exact exchange price being fixed by the bargaining between the last two points.

If, as is usually the case, there are many prospective purchasers and prospective sellers, a *market* price is established

according to the well-known rule as laid down by Böhm-Bawerk,[1] the purchasers with highest subjective exchange values being paired off against the sellers with lowest subjective exchange values until the final pair is reached who determine the market price. The subjective exchange value of this final purchaser must evidently be higher than the subjective exchange value of the final seller and higher than the subjective exchange value of the next possible purchaser. The subjective exchange value of the final seller must likewise be lower than the subjective exchange value of the final purchaser and lower than the subjective exchange value of the next higher seller in the market. Between these points the price is fixed by bargaining.

In land sales, the use value to either the seller or the purchaser is apt to play a much more important part than is the case in the sale of most manufactured or agricultural products. This is due to the fact that, frequently, either the seller or the buyer wishes the land primarily for his own use and does not value it simply because it may be exchanged for other commodities. In such cases, value in use exerts a powerful influence on the subjective exchange value of the actual or prospective user but this does not alter the fact that the market price is determined only through the inter-action of subjective exchange values in the manner heretofore described.

A market price, then, is the result of a number of sales which have taken place at nearly the same time and at approximately a uniform price. This market price is commonly imputed to all other similar units of the commodity in the vicinity but it is by no means correct to suppose that all the other units, if placed on the market at once, could be sold at this price. On the contrary, this flooding of the market would almost certainly cause the price to fall decidedly. The market value of most commodities tends to fluctuate constantly about a point known as the normal value. This signifies merely the ordinary resultant of two forces, namely the demand for the commodity, depending upon its utility, and the supply of the commodity, depending upon limitations imposed by nature or upon the dis-

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[1] Böhm-Bawerk, Eugene Von. *Positive Theory of Capital*, Chap. 17.

utility involved in its production. In the case of reproducible commodities, the supply can, quite readily, be varied to correspond with fluctuations in demand, hence changes in the normal *value* are ordinarily slow. Normal *price*, may change more rapidly since it is affected also by a third factor, the change in the money supply of the country.

The normal value of land is, however, in rapidly developing countries, much less stable than the normal value of most other commodities. This is due to the fact that the supply of land in such locations cannot readily be increased except at great expense. Therefore, every fluctuation in the demand for the products of the land will result in an equal or perhaps even larger change in the value of the land. A doubling of the demand for wheat might not double its value since new lands would immediately be opened up, wheat would displace other crops on part of the old land and hence the amount of wheat raised would increase. Nevertheless, this doubling of the demand for wheat might more than double the rent, for rent depends upon the margin above the cost of production. If, at present, a farmer sells his wheat at one dollar per bushel and it has cost him eighty cents to produce it, he could only pay twenty cents per bushel for rent but if the price rises to $1.30 per bushel, the cost of production might not be increased to more than ninety cents per bushel, leaving forty cents for rent. In this case, then, an increase of thirty per cent in the price of wheat just doubles the rental value of the land. In a country of increasing population, as soon as the most fertile lands are occupied, a continual rise in rents seems inevitable as long as the inhabitants increase in numbers. Evidently, then, we must also expect a continual rise in normal land values. If, at the same time, the quantity of money in the country happens to be increasing more rapidly than its uses, normal price will rise even faster than normal value while a decrease in the relative money supply would, on the contrary, cause normal price to lag behind normal value.

In a static condition of society, the normal value of land could always be determined by capitalizing the rental value of the land at the current rates of interest, but, in a dynamic

state, this is by no means true for land dealers habitually discount the total expected increases in future rent payments and add the sum of these amounts to the capitalized rent. Thus, we see vacant lots which bring in no rental but are valued at many thousands of dollars because of the high rents they are expected to yield when built upon at some future date. If population in a given country has steadily increased in the past, it is perfectly logical to expect the increase to continue, hence, in such instances, a reasonable estimate of present normal value necessarily includes an allowance for these almost certain increases in future rentals. In conclusion, then, we may say that normal price tends to vary directly with: first, changes in rental value; second, anticipated changes in rental values in the future; third, changes in the relative money supply.

The market values of most commodities only occasionally correspond exactly with the normal values. This is due to three principal causes: first, unusual changes in the supply; second, unusual changes in the demand; and third, speculative influences. In the case of land, the first factor may be ruled out since the supply is relatively constant and, since rent has considerable inertia, the second frequently acts only by influencing the third. Speculation is perhaps as rife in the case of land as in that of any other commodity. A temporary rise in the prices of land products is likely to lead to the belief that extraordinary profits may be obtained from land investments and so inflate land values far beyond the normal. In many cases, inflation is primarily a result of the gambling spirit, each purchaser hoping to buy and sell again at a good advance before the boom breaks. A large degree of inflation above the normal value is seldom long-lived but a moderate degree of inflation may continue for several years as is true of semi-arid lands during and immediately after a rainy cycle of years or in a new country into which a paper railroad company perennially proposes to build a line, the real purpose being to enable the promoters to profit by land speculation.

It might seem that valuation for purpose of taxation should be based on the normal price of the land at the time of assessment. Section 1052 of the Wisconsin Statutes, however, ex-

pressly provides that "Real property shall be valued . . . at the full value which could ordinarily be obtained therefrom at private sale." This seems to imply distinctly that the current market price at the time of assessment and not the normal price is the only basis for this kind of valuation in the state of Wisconsin. It therefore devolves upon the assessor to determine as accurately as possible the price at which each parcel of land would sell at the date of assessment if it had been placed upon the market several months or a year before and had actually come under the consideration of a number of men who were both able and willing to buy at what they believed to be the market price.

The reason that the law specifies that the valuation must be based upon the price which could be obtained at a private sale is doubtless owing to the fact that, in the case of real estate, such a large amount of cash is required for purchase under the usual terms of a forced or sheriff's sale that but few purchasers are attracted and it is often true that those who, at some date in the near future, would bid far higher are either unaware of the sale or are not in a position to make the purchase at that time. Thus, a forced sale usually means a lower market price than a private sale.

A private sale may be considered to be an auction covering a considerable period of time in which prospective buyers are given an opportunity to arrange their finances for the purchase and also to look over the various pieces of property for sale and compare their prices while, at the same time, the sellers, by advertising, are calling into the market the maximum number of prospective purchasers and are gradually estimating by means of offers made or other criteria the various subjective values placed on the land by the buyers. In a locality, however, in which prospective purchasers are scarce and sales take place at only rare intervals, a real market price can scarcely be said to exist. Actual or anticipated changes in the price of products of the land have, naturally, caused fluctuations in the subjective or subjective exchange value placed on the land by the owners or others. As a result, the price paid for the last piece of land sold can no longer be legitimately imputed

to all other land of like quality in the neighborhood. The best which an assessor can do, in such a case, is to estimate the probable price at which the given piece of land would sell if actually changing hands under the new conditions. In making such an estimate, two criteria are available for his guidance. If, in the community, land values are relatively stable it is probable that the changes therein since the last sales of similar pieces of land occurred have been in about the same percentage as the changes in rental values and the latter can usually be determined with comparative ease. If, however, land values are largely speculative, it is likely to be much more accurate to estimate the relative change in value of other lands of like nature under similar conditions even if these lands are located at some distance from the piece in question, or by the relative change in the value of lands used for the same purpose even if differing considerably in quality.

Another difficulty in evaluating land is that it can by no means be safely assumed that scattered sales represent stable market prices for each variety of land. Sellers are often discouraged or in need of money and sell far below the typical selling price of the time simply because, at that specific date, regular buyers happen to be short of funds or have failed to get in touch with the man who desires to sell.

On the other hand, some man may pay an exceptional price for a certain piece of land that adjoins his farm and which he is especially desirous of owning or for an adjacent lot which will accommodate an addition to his store, or, in a closely built city, for a considerable open space suitable for the erection of a large business block.

These cases do not seem to be in harmony with the spirit of the law since they do not represent "the full money value which could *ordinarily* be obtained therefrom at private sale."

It is evidently impossible to determine the *exact* market value which any piece of real estate will possess under usual conditions but, nevertheless, it must be assessed and the duty of the assessor is to approximate the desired result as closely as possible. This is all that can be hoped for and, since no form of taxation is entirely equitable, little complaint can be made if

this end is attained. One circumstance which tends, in general, to assist the assessor in this endeavor is that, when values are fluctuating rapidly, the sales are ordinarily most numerous and this fact tends to keep the price fairly well marked while, in periods when sales are very rare, values are somewhat more stable and tend to approach the normal, even if inflated considerably above it at the beginning of the period of stagnation.

Several forms of exceptional sales should be mentioned before closing this topic. Many sales are merely transfers within the family and the nominal figures entered in the records have no significance. This doctoring of the records holds true in respect to a large share of the real estate transfers hence the assessor is by no means justified in depending on these official records without carefully substantiating them from outside sources. In a large percentage of all sales the consideration is merely entered as "one dollar." In numerous other instances the recorded consideration is larger than the actual selling price, the purpose of such entries being to facilitate future transfers at high prices. In such cases, if the present owner believes that the recorded price is likely to be used as a basis of taxation, he will normally be more than willing to assist in removing the padding.

Another type of sale which cannot be used legitimately as a basis for valuation is the so-called "sucker sale." Occasionally, some new-comer will prove an easy victim to the wiles of a real estate salesman and be inveigled into buying a tract of land at a price far in excess of either normal or ordinary market value. It is evident that the chance of such a sale is a valuable asset to every land owner in the vicinity just as a lottery ticket is a thing of value to the holder. At first thought, it would seem that to obtain the true market value of other pieces of land sold, the value of this chance should be computed and added to the actual sale value in each case. On further consideration, however, it seems probable that all those parties dealing in land at the ordinary prices took the value of this chance into consideration and added it to their subjective exchange values. It already appears, therefore, in the actual exchange price and to add it again would be a duplication of values.

A somewhat similar case is that in which agricultural, grazing, or timber land along a narrow stream valley may be utilized for the location of a power dam, the site in this case attaining a very high value. If, however, there are ten tracts of land equally available, it is evident that, logically, the surplus above the agricultural value of each tract should be exactly one-tenth of the increase in value accruing to the tract actually chosen for the power site, discounted for the estimated length of time which will elapse before the dam is actually built. If any considerable number of these tracts have actually been sold, this chance value will ordinarily appear in the selling price and the assessor may take these sales as his guide. The amount actually added to the selling value is likely to be quite variable since the contracting parties will not be equally sanguine as to the actual enhancement in the value of the site chosen at the time of construction or as to their particular chance of selling for this purpose. Neither will they all agree as to the probable period which they must wait before the construction is decided upon. As a result, if tracts are sold, the prices may differ greatly, and perhaps no tract has changed hands since the prospect of utilization as a power site first attracted public attention. Under these circumstances, though it is the duty of the assessor to base his estimates upon values that *are* and not upon values that mathematically *ought to be*, it is probable that by computing the chance value by the simple mathematical rule he may approach more closely to the average price which may be obtained for the plots of land in question than he could by basing his estimates upon one or two stray sales.

In evaluating lands, it is desirable to attain a greater degree of equity than has usually been done under the present methods of assessment. Today, in most localities, two similar tracts lying side by side may be taxed, year after year, at decidedly different rates. In most instances, the owner who pays the higher tax is entirely unaware of the fact that any inequality exists since the chances are that his lot is not assessed at more than a fair market value and he has therefore never been led to investigate the tax roll and thus discover

that his neighbor is escaping with a much lighter burden. If, perchance, he discovers this fact and complains to the Board of Review he cannot legitimately object to his own assessment and he sees little direct benefit in getting his neighbor's assessment raised. The practical outcome is that inequalities of considerable size exist in large numbers of cases and during long periods of time and yet complaints and corrections are comparatively rare.

It is necessary, then, to find some practical remedies for this state of affairs. The most important ones thus far discovered seem to be as follows:

1. Assessment of all property at full value.
2. Assessment by trained assessors holding office for long terms.
3. Complete publicity.
4. A definite system of valuation.

The reasons for applying each are as follows:

First Remedy: That any person assessed at more than the market value of his property may come before the Board of Review with a legal as well as a moral claim for justice and equity and that a cumulative system of under-assessment is less likely to develop.

Second Remedy: Assessment by trained professional assessors is necessary for three reasons. An assessor who devotes only spare time to this work may be engaged in some other business which would be greatly injured by the ill-will of some of the leading property-holders of the community. Furthermore, he is seldom competent to employ a modern scientific system of valuation and often has neither the time nor inclination to become proficient in such a system. Finally, he usually holds office for too short a term to be especially interested in thoroughly learning his profession and if, by any chance, his predecessor has worked out a good system of valuation he seldom understands it or is able to continue it properly.

Third Remedy: Complete publicity is essential in order that each taxpayer may know just what system of valuation is being followed, consider its merits, and have the opportunity

of registering his protest against any inequalities or efforts to impose upon him more than his just burden.

Fourth Remedy: This applies primarily to city lands. Urban land values, especially in a district devoted to any single purpose, rarely vary according to location with any great abruptness. It is possible, therefore, by a system of gradation to approximate more closely to the correct present market value of each lot than by any possible attempt to make the value of the lot depend upon the past transfers of that particular piece of ground.

These four remedies being, then, essential, the next thing to be considered is the method of securing the benefits of each.

First Step: To obtain assessment of real estate at full value, supervision of assessment by the state is necessary. State taxes should, in no case, be wholly dependent upon the valuation returned by local assessors for abundant experience has demonstrated that this almost invariably results in under-assessment of local property in order to evade as large a share of the state tax as feasible. The Wisconsin plan of checking up local assessments by their relation to actual sales values seems to be a quite effective method of overcoming this obstacle. By this method, the total assessed value of the county is raised in the same ratio as that which the actual sales recorded in the county bear to the assessed value of these pieces of property. Under these circumstances, under-assessment becomes of no avail to the county since state taxes are in no way lessened.

Second Step: To obtain the services of trained assessors it is necessary to have them appointed instead of elected and no person should be eligible to appointment who had not first passed a rigid examination to show his preparation and fitness for the position. A permanent tenure of office, subject to removal by the appointing official, on statement of cause, would add the necessary responsibility for his conduct. As far as land valuation is concerned, the chances of graft or favoritism on the part of the assessor are reduced to a minimum when a graded system of valuation and full publicity of methods is insisted upon. Under this plan of assessment,

it naturally follows that the size of the districts should be such as may be carefully assessed and the assessments kept up to date by an assessor devoting his entire time to this end. Much of the computation and clerical work might, of course, be performed as well by lower salaried clerks.

Third Step: Publicity is necessary both before and after assessment. In the case of urban real estate a map showing the unit values tentatively adopted by the board of assessors should invariably be published and submitted to the criticism of the tax payers several days previously to the date at which the unit values are definitely fixed. Again, after the assessment has been completed, lists showing the value of each piece of property as determined upon by the assessor should be posted in conspicuous places. By referring to these lists, the tax payers may more easily detect errors in assessment or cases of discrimination. The taxpayers have a right to demand this knowledge and the fair-minded assessor should never object to full publicity as to the methods and results of his valuation.

B. Urban Lands

As has before been suggested, urban lands have a distinct tendency to rather steady gradations in value depending upon relative location. This fact renders it possible to devise more or less accurate mathematical systems of valuation. Mr. W. A. Somers of St. Paul was one of the pioneers in this line and he has worked out one of the most complete plans yet put into practice. It consists essentially in determining the value of the lot located in the center of the street-face of the highest priced block in the city, or in a given section of the city, and scaling all other values in accordance with this standard.

The first thing necessary in this process is to decide as to which block on which street is the choicest and hence has the most valuable business frontage in the city. To determine this, the assessor may have access to sales records or opinions of real estate men and others familiar with land values in the vicinity. Another method, which was used in Cleveland, was to count the passers-by at each of several points in the busi-

ness section.[1] While this is not an absolute measure of relative land values, it at least gives an approximate guide and is probably the best single criterion available.

Having decided upon the most desirable location in the city, the next proceeding is to divide the city into districts according to the character of business or of residences in the various parts of the city, arranging the boundaries so that each district will form a comparatively homogeneous unit. The retail business district should constitute a single unit, the wholesale district, if compact, another, and so on. It may be that a city is divided into segments and that two or three locations represent value summits from which values fall off in all directions. If so, each value peak should constitute the center of a district of its own.

After the city has been completely divided into districts, the next essential is to determine the front-foot valuation of a lot of standard depth at the minimum value point of each side of each block in the district. It is preferable to choose the point of minimum value rather than the center of the street-face of a block as the basis for valuation because of the fact that the cross-street traffic on one side may, because of disproportionate volume, exert a much more powerful influence than the cross-street traffic on the other side. This point will be discussed more fully later.

A strip 1 x 100 feet with its end abutting on the street is the unit of area upon which all valuations are based, 100 feet being a convenient length for all calculations. The great advantage of a unit system of valuation, instead of recording the frontage values for the actual lots as laid out, is in the fact that the unit system permits of a ready comparison of values in any block in the city with any other while, without a unit system, such a comparison would be manifestly impossible.[2] The minimum unit values on the four sides of the highest priced blocks in the district are first to be determined and then those for the blocks adjacent until the entire district has been covered.

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[1] *First Quadrennial Report of Board of Assessors of Real Property in Cleveland Ohio*, p. 12.
[2] See W. A. Somers' article in the *Single Tax Review*, vol. 26.

PROBLEMS OF ASSESSMENT

It is necessary to solve four distinct problems before the assessor can determine the ground value of the various properties in his district.

1. To fix the value of the first lot.

2. To secure a correct adjustment of the other values thereto.

3. To ascertain the effect of lot depth on value.

4. To determine the importance of the corner influence in enhancing the value of lots.

City lots, unlike agricultural lands, are not often valued primarily because of the quality of the soil but generally because of the fact that they furnish more or less convenient sites for buildings, of one kind or another. A judiciously constructed building will yield an income more than sufficient to pay interest on its cost. This surplus income is expected to continue for many years and the present worth of all anticipated future surpluses arising from this or other buildings on the same site constitutes the ground value. Thus, the ground value cannot be computed without reference to buildings and their rentals. In the following chapter, therefore, the valuation of land and buildings will be considered.

CHAPTER II

VALUATION OF LAND WITH BUILDINGS

A. General Methods

In computing urban realty values, the assessor has two distinct methods at his disposal.

1. He may mathematically compute what the property should be worth considering present and anticipated rental values, cost of reproduction of buildings, etc.

2. He may determine the selling value by studying the records of transfers of this or similar adjacent property and may occasionally profit by securing the opinions of real estate dealers as to its market value.

The principal objection to the first plan is that it does not exactly conform to the law which proposes to tax property according to what it will actually bring in the market rather than in accordance with what it should logically sell for. On the other hand, unless transfers have been numerous in the vicinity within a comparatively recent period or unless values are decidedly stationary, an assessment based on capitalized rentals is likely to be a better criterion of present selling value than are estimates from former sales.

If land is to be valued by capitalizing rent, the question arises as to the method of capitalization and its accuracy.

At first thought, it only seems necessary to divide the net rental of a given piece of property by the current rate of interest to obtain its true value. This would doubtless be approximately true under a static condition of society, but, with dynamic conditions at work, entirely different results ensue. Thus, we may find a building whose gross rental is $10 per month, which, capitalized at 5 per cent, would amount to

$2,400, situated on a lot valued alone at $5,000. Why the discrepancy? Evidently because an increase in rent is anticipated either from increasing population or through the erection of a new building and the future hoped for income is already discounted and added to the price of the lot. In valuing a lot, therefore, this factor must invariably be taken into consideration. Otherwise, vacant lots would always go untaxed—a policy not in accord with the tenets of the Wisconsin law.

Before we consider the problem solved we must also answer the question definitely as to just what we mean by the terms "current rate of interest" and "net rentals." We shall proceed to consider these in order.

B. Current Rate of Interest

The first of these phrases seems to presuppose that, at a given time and place, the interest rate is fixed and definite. As a matter of fact, this is far from true for the rate actually varies widely according to the amount of inconvenience and risk involved and the duration of the loan. Panama Canal bonds bearing only 2 per cent interest sold at par but, at the same time and place, many loans were being negotiated at rates of 5 per cent, 6 per cent, 7 per cent, or even 8 per cent or 10 per cent. Nevertheless, for loans of a specific character, there usually does exist a fairly well-defined market rate. The same may be said concerning the ordinary returns upon investments of as common and well-understood a nature as the construction of houses and buildings. The gross returns upon such investments are perhaps considerably higher than the rates on mortgages in order to compensate the owner for extra risk and trouble involved in the management of the building. The difficulty of ascertaining the average rate of return expected on the investment is complicated by the fact that, in regions of growing population, a certain percentage of increment in the site value is commonly anticipated and this causes the owner to be satisfied with a much lower return in the shape of present net rentals than would otherwise be the case.

Despite these difficulties, it is essential for purposes of valuation that the normal rate on investments in buildings in the given city at the given date be ascertained. In the typical American city, new buildings are constantly being erected and it seems safe to assume that the net return on the investments in these buildings cannot long differ materially from that received on other investments of a like degree of safety. The trouble of building might seem to demand a higher rate on the investment than would be received on first mortgages but this is largely offset by the fact that there is a greater degree of pride of ownership evolved by owning buildings than by possessing mortgages. Many persons enjoy, rather than dislike, the process of planning houses or other structures. The majority of building owners underestimate the necessary allowances for depreciation, repairs, non-rentals, taxes, etc. For these reasons, it seems probable that the actual net return from buildings is no higher than the interest rates on gilt-edge first mortgages on property of the same character located in the same vicinity. This rate of interest, then, will be assumed to be the most practical one to use in the capitalization of future income to arrive at present values. The next topic for consideration is a study of the methods of computing the net annual rental.

C. Net Annual Rental

The determination of the gross rental of a property must precede the computation of the net rental. The gross rental cannot be considered merely as twelve times the present monthly rental for a certain percentage must be deducted from this amount because of the fact that buildings are not steadily occupied. The percentage allowance which must be made for this reason may, in some cases, be obtained by inquiries from real estate men and owners of buildings, the average estimate being assumed correct for this purpose, but, as a rule, the records of landlords are too incomplete to be of much real service. One of the best methods of obtaining a correct estimate of the probable loss of rentals through vacancies is to count at different seasons and in different years

all the buildings of a given type in a given district, keeping a record of those empty. In this way, the percentage of idleness may be computed with a fair degree of accuracy. In office buildings, the number of vacant offices compared to the total number or the percentage of vacant floor space compared to the total floor area might be used as criteria. Similar methods might be applied to other types of buildings and, in this way, a complete record be evolved. From the gross annual rental thus arrived at, further deductions must be made for repairs, insurance, heat, light, or other service furnished, and actual labor in caring for the building. Taxes should be deducted only to the extent that they are heavier than on other investments, the excess tax alone being subtracted. The *gross* annual rental less all these charges gives the *net* annual rental.

D. The Valuation of Buildings

It is a well-known and generally accepted principle of economics that the value of a freely reproducible commodity tends normally to equal the cost of reproducing the good. If the value is greater, more of this good will be produced and thrown on the market; if less, the present supply will be consumed and no more will be created to take its place until the value again rises to the cost of production. This principle applies to buildings just as to other commodities, hence, in valuing them for taxation, it is common to use the cost of construction as the proper basis for assessment. In a very rapidly growing city, values, for a time, might outrun costs of production but this would be but a fleeting phenomenon. During a period of depression, the values of new buildings often fall below their cost of construction but, when the panic is over, these values will once more approach the costs, for the cessation of building during the crisis will tend to bring prices up again. These exceptions, then, are insufficient to vitiate seriously the cost method of valuation.

Buildings, however, are, as a rule, a very durable species of commodities and, when we consider durable commodities, we find that the cost method of valuation becomes more difficult.

This difficulty arises from the fact that, as time passes, the conditions of supply and demand change and, hence, those relationships of goods known as values must change also. Let us consider, then, some of the difficulties encountered when we attempt to value buildings from a cost basis:

1. Let us suppose that the value of building material, as compared with that of commodities in general, has gone up. How will this affect the price of building? In a rapidly growing city, the rate of building will evidently be somewhat checked,—rents will rise, and hence values will soon increase to the new cost of producing buildings. It must be noted that cost of reproduction and not original cost of production now becomes the governing factor of building values.

In a city of stationary population, a rise in the price of materials might not affect building values for many years. There would still be as many buildings as before; rents, and therefore values, would not rise until the existing buildings decayed or became obsolete. The rise in rents might be discounted somewhat in advance of its actual occurrence thus enhancing values before rents rose but the fact would still remain that many years might elapse before the value of buildings would equal their cost of reproduction.

2. Let us suppose that the value of building materials has fallen as compared with other commodities. In this case, building would be stimulated and the price of buildings would still remain equal to their cost of reproduction.

3. Suppose there is a general rise in prices due to a changing volume of money. Such an increase of money would evidently send up rents in the same ratio as the rise in other commodities, hence, values would keep pace with cost of reproduction as before.

4. Suppose that interest rates rise. Since building values are computed by capitalizing rent, these values would evidently fall and, in a city of stationary population, the effect would be similar to that arising from an increase in the cost of building materials. In a city of growing population, however, the slackened building rate would quickly cause a readjustment of values to the cost of reproduction.

5. Suppose the city decreases in population. In this case,

building values would fall below the cost of reproduction until the decrease in supply of buildings through decay or obsolescence attained a more rapid rate than the decrease of population.

We see, then, that several of these conditions might cause values to depart from cost of reproduction but they are not as serious in practical life as it might seem. We have comparatively few cities of stationary or decreasing population. Interest rates on well-secured, long-time loans change slowly if at all, allowing ample time, as a rule, for readjustment to the new conditions. Hence, the theory of cost of reproduction remains, in these respects, unscathed for the great majority of cases.

The cost of reproduction theory of value has, however, some weak features which have not as yet been touched upon. Buildings begin to deteriorate as soon as finished. They not only weather, wear, and decay but they become old-fashioned or unsuited to the location. No one could, if he tried, actually reproduce a deteriorated building in its existing condition. Furthermore, no one is desirious of so doing even if it were practicable. The cost of reproduction, in this case, is, then, a purely imaginary quantity.

The supporters of the cost of reproduction method of valuation will tell you that the proper method is to compute the present cost of producing a similar new building and then to deduct therefrom the percentage which the building has depreciated, thus arriving at the present value. In just what manner is this percentage to be arrived at? By what method can one determine just when a house is one-third, or one-half, or three-fourths worn out? Must such a test be made microscopically, chemically, physically, or psychologically? In certain parts of a large city, one sees fine residences, not worn out or dilapidated but still selling for less than half what it would cost to build them. Why? Simply because that section of the city has become smoky, because undesirable neighbors have moved into the district, or even because the foibles of fashion have decreed that another section of the city is alone aristocratic. The actual depreciation in value is 40, 50, 60 per cent, or even more. By what set scale can this be measured?

These examples serve to make clear the fact that no measure

of physical depreciation is possible and that any such measure of depreciation would be useless even if it could be computed. What, then, is the correct basis to use? The answer may be to make it proportional to the fall in rentals. Ordinary experience, however, would show that before the decay of the building has caused rentals to fall 50 per cent, the building itself is practically worthless. In many cases, in a growing city, the building may now rent for more than ever before in its history and yet it is ready to be torn down tomorrow—in other words it has depreciated practically 100 per cent since it is no longer suited to the site and hence is worth only salvage value.

These facts serve to prove that the rate of depreciation cannot be measured physically and does not vary directly with the fall in rentals. What, then, is really indicated by the term depreciation as applied to buildings? How may a depreciation curve be plotted? One may, of course, simply assume a straight line, or, in other words, divide the cost of the building by its life in years and annually deduct the quotient from the value for the preceding year. What assurance has one that this even approximates the facts of the case? For purposes of taxation, we wish to estimate the value for each year with as great a degree of accuracy as practicable. What is the best method for attaining this end?

Before we can compute any scientific depreciation curve, we must consider more carefully the correct basis of value. A traveller crossing a desert may have a quart of brackish water in his canteen which has been transported two hundred miles and whose cost might be estimated at five dollars' worth of labor. If, however, no other water is known to exist in the vicinity and he has fifty miles yet to go before reaching an oasis, he perhaps would not sell that quart of water for a thousand dollars. Nevertheless, if, an hour later, he stumbles upon a spring of pure cold water, he drinks to his fill of the refreshing fluid, pours out upon the sand that quart of water which an hour before was valued by him at a thousand dollars, and refills his canteen with the cool, sparkling product of the spring for which he pays not a cent and, as a consequence of its abundance, is willing to give of it freely to anyone asking him therefor. Thus, we see that cost may have no connection with present value. In fact, the only relation to value

which it ever has is that it helps us to estimate what the future supply of the commodity is likely to be. Value is always directly based on anticipated future income, on services which it is expected will materialize in the future. This is as true of buildings as of any other commodities and this fact must be kept in mind before we can compute any curve of depreciation which may make any claim to scientific accuracy.

We know that the value of a newly completed building is equal approximately to its cost of construction. It is also equal approximately to the sum of the discounted anticipated net rentals during the whole life of the building. Anything changing the general anticipation as to the rentals that will probably accrue in the future will change the value of the building. Value, therefore, is based not on what has happened or will actually happen but upon what people generally expect will happen. If it is anticipated that next year it will be profitable to erect a new building on the site now occupied by the existing structure, then the value of the present building cannot exceed a year's net rental plus what it will bring as salvage. In figuring depreciation, one must always bear in mind the fact that the cumulative percentage of depreciation must approximately reach one hundred at the date at which it will be necessary to replace the building even though up to that date the building continues to rent for a large fraction of the amount received when the structure was new.

To find the value of a building at any given date, it is, therefore, frequently easier and more accurate to look forward instead of backward, to consider future rentals rather than past cost of construction. If the building would last forever, the rent remaining constant, the capitalization would be a very simple matter. As conditions actually exist, the problem becomes more complex.

In obtaining the capital value by the process of capitalizing income, land and building must necessarily be valued together since the income is derived from both jointly. It is asserted by the Cleveland Board of Assessment that their investigation showed any attempt to use rentals as a basis of valuation to be entirely hopeless. On page 10 of their First Quadrennial Report, they make the following statement: "Had the Board given rentals the undue consideration demanded by large

property owners, unimproved land on Euclid Avenue would have escaped taxation and many of our skyscrapers, which are here not enumerated solely for the reason that they may not be further depreciated by us, would be entitled to absolute exemption—indeed we might say to a dividend out of the public treasury."

In spite of the above point of view taken by this Board, it seems safe to assert that, in dealing with any but comparatively new buildings, a valuation based on *anything else than rentals* is fully as likely to be faulty as is one calculated from this basis alone. If the Cleveland skyscrapers failed to pay interest on their cost, they were evidently not worth their cost and should by no means be assessed on that basis for the owner has already been penalized for his bad judgment and it is unjust to penalize him further by excessive taxation. If the unimproved land on Euclid Avenue were always to remain unimproved, it would probably be valueless and hence should properly go untaxed. The excuse for taxing it is that improvements thereon are expected and that the anticipated rentals therefrom are already capitalized, giving value to the land.

The method of basing values on expected rentals allows us to dispense largely with past records of cost, variations in prices of building material, changes in the character of the district, etc. We need only deal with the outlook for the future. What, then, is the practical mode of procedure?

The first step is to find the present net rental according to the method previously discussed. It will be noted that no deduction is made for depreciation.

The second step is to estimate the period of time which will elapse before the present building will be worn out, discarded, or replaced by a new structure. In considering the relation of net rentals to the present value of a piece of city property, we must take into account the type of building existing thereon, its probable life, and its fitness for its location. Suppose that we have two similar lots standing side by side, one occupied by a two-story brick structure, built twenty years ago and the other by a modern four-story concrete and steel edifice. Let us assume the following figures for the two buildings in question, the condition of society being static.

TABLE I

PROFITABLENESS OF NEW BUILDING

	Lot A Old Bldg.	Lot B New Bldg.
Annual rental	$4,500	$10,000
Excess taxes, insurance, repairs, heat, light, etc.	1,300	2,000
Net income	3,200	8,000
Probable future life of building in years	10	50
Estimated present worth of future income	25,000	150,000
Cost of construction of new building	....	130,000
Surplus income above cost	25,000	20,000

Evidently, in this case, replacement of the old building with a new one will prove unprofitable. Let us see if we can derive a general rule showing when such replacement is profitable and when it is not. The following hypothetical table will help to illustrate the principle:

TABLE II

REPLACEMENT OF OLD BUILDING

i Net income from old building.	p Net income from most profitable building.	p − i Net gain in income by constructing new building.	Σ(p − i) Present worth of future net gains from new construction	C Cost of new building above salvage gain.	Σ(p − i)− C Net gain from new construction.
$500	$7,000	$6,500	$130,000	$100,000	$30,000
1,000	7,000	6,000	120,000	100,000	20,000
1,500	7,000	5,500	110,000	100,000	10,000
2,000	7,000	5,000	100,000	100,000	0
2,500	7,000	4,500	90,000	100,000	—10,000
3,000	7,000	4,000	80,000	100,000	—20,000
3,500	7,000	3,500	70,000	100,000	—30,000
4,000	7,000	3,000	60,000	100,000	—40,000
4,500	7,000	2,500	50,000	100,000	—50,000
5,000	7,000	2,000	40,000	100,000	—60,000
5,500	7,000	1,500	30,000	100,000	—70,000
6,000	7,000	1,000	20,000	100,000	—80,000
6,500	7,000	500	10,000	100,000	—90,000
7,000	7,000	0	0	100,000	—100,000

This table shows that, in case the old building brings in a net return of more than $2,000 per annum, such replacement will be unprofitable since the increase in net income, capitalized, will be less than the $100,000 required to construct the new building. This presupposes that the salvage from the old building will be just sufficient to pay for the cost of removing it—an assumption which, while never exactly true, probably approximates the usual condition of affairs.

We see further that it is only profitable to replace the old building by a new one if the difference in the present worths of the sum of the future incomes of the two structures is greater that the entire cost of the new one. Translated into mathematical language this rule appears as follows:

If I=present worth of all future rentals of old building,
  P=present worth of all future rentals of most profitable type of building,
  C=cost of construction of most profitable type of building,

Then if $P—I>C$ it will pay to replace the old building by a modern structure, otherwise it will not. As has before been pointed out, the value of a new building is, under ordinary conditions, equal to its cost of construction. Conditions cannot long exist which award any net surplus to the builder, for competition in building lines is usually very keen. As a result of this fact, it follows that a building cannot profitably be replaced by a new structure as long as it yields any surplus return whatever above the ground rental. The ground rental is determined by the surplus return afforded by that type of building which is most profitable at the given location. Therefore, as long as the old building brings in more net rental than the surplus net rental which could be obtained by the construction of the most profitable type of new building, the new building will, ordinarily, not take its place. This fact may be made more clear by the use of the following hypothetical example. Suppose that a lot is occupied at present by a two-story brick store erected thirty years ago. The owner sees that all about his property new four to six story buildings are being erected. He therefore begins to figure on the proposition of replacing his store by a more modern structure. His computations should be as follows:

Annual net rental of new building	$3,600
Probable life of new building	30 yrs.
Present worth of total probable rentals for thirty years, 5 per cent. interest	$50,000
Cost of new building	40,000
Surplus ascribable to land (land value)	$10,000
Interest on land value at 5 per cent, per annum	500
Annual net rental of old building	960
Net loss per annum by erecting new building	$460

If wise, he will, therefore, not erect the new building. If, however, at any time the interest on the surplus ascribable to land becomes larger than the annual net rental of the old building it will pay to replace the building at once. It will be noted that neither the probable life of the old building nor its cost are in any way factors in the problem. Just as long as a net surplus may be obtained by retaining the old building, it pays to retain it.

The principle just explained may perhaps be made more clear by the use of a diagram such as the following:

Let A B=Present net rental of land and building.
B K=Present net rental ascribable to building.
A K=Present net rental ascribable to land.
A D=n=Probable life of building in years.
C D=Net rental of land n years hence=net rental of land and building at time of replacement of latter.

Draw C E || D A

Then C D=A E .·. A E=Net rental of land n years hence

Let B E=p. C D=E A=f=minimum future rental.

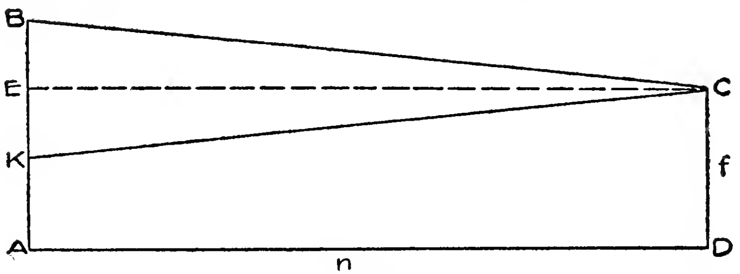

FIGURE 1

In the diagram given above, we see that the net rental gradually falls off until at the end of n years the net rental ascribable to the building, or B K, has reached zero but, at the same

time, the share due the site has been steadily increasing. This figure would be applicable to a community of moderately slow growth. In another city in which population, and hence rents, were increasing with great rapidity, the figure would appear as follows, the lettering being identical with the preceding:

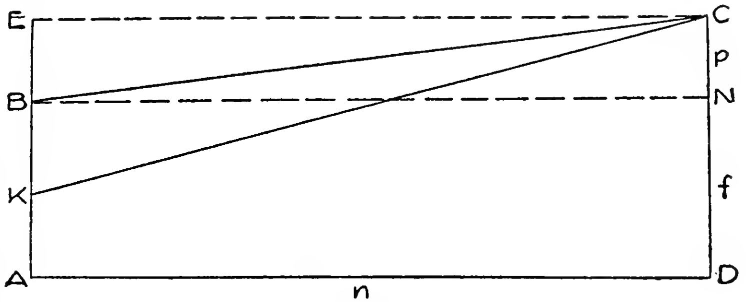

FIGURE 2

p now becomes represented by C N as well as by E B since, by construction, E C || B N || A D. Similarly, f now equals A B or D N.

Other figures might easily be constructed for the cases in which the rent of the land is stationary or diminishing but the principle would remain unchanged. In each case, it is evident that, under proper management, the replacement of the building will occur at the date when the converging lines B C and K C meet. One of the concrete problems of assessment, therefore, is to determine approximately the date of this intersection.

In the figures, for the sake of simplicity, B C and K C have been represented as straight lines. In practice, it is quite certain that they will be decidedly irregular. It is possible that a curve may be worked out which will more closely approximate the normal for B C than does a straight line. In the case of K C, it seems quite doubtful that any curve will be more generally applicable than the simple line. At any rate, we shall assume for the present that a straight line approximates the results in each case and proceed to consider the concrete methods of determining the pitch of each line.

We must all base our judgments of future events on the happenings of the past. We anticipate that rents will rise or fall

in the next twenty years at approximately the same rate that they have done during the last twenty years. Actual sales and trades are continually made on this assumption hence it becomes a legitimate basis for fixing values. In determining the slope of the line B C, we must, therefore, turn to the records of the past. By collecting data concerning the change in rentals of a large number of individual buildings of a given type since the dates of their construction, we should, by a process of averaging, arrive at an approximation of the correct slope of this line for this given kind of building in a given locality. Such lines should be constructed for each type of building in each section of the city. The probabilities are that the angle B C K would be found constant for the same type of buildings in all locations in which weathering and normal wear and tear were the chief causes for depreciation.

The slope of the line K C must be determined in a similar manner. Since land value tends to vary in the same proportion as net rent, the record of sales of given pieces of land at various dates in the past should furnish one of the safest guides for this purpose. A large number of records in a given district should, when averaged, prove a valuable guide for estimates of future changes in land rents.

In most instances, the proper records of the past are hard to find. This emphasizes the necessity of a city keeping complete records of sales and rentals of all property within its borders and these records should be filed in such form as to be easily accessible to investigators. All records for a given building or parcel of land should be filed consecutively from year to year. In this manner, a complete history of each property is rendered available as a guide for future action.

By the use of such records as may be obtained, the probable life of each type of building for each section of the city should be worked out and recorded for the use of the assessors. Under ordinary conditions, the future life of any building should equal its normal expectancy minus the number of years which have elapsed since it was built. The assessors should use this figure as a basis of departure but, in definitely setting a value for n, each assessor must be expected to use good judgment concerning changes in the character of the locality, exceptionally good or

poor maintenance of the specific building, etc. By exercising careful discretion, the value of n should be approximated with a reasonable degree of accuracy.

Having determined the slope of the line K C representing change in land values and having determined upon the approximate value of n, it is next necessary to decide upon the present land income or rent represented by the line A K. As a rule, this may be roughly approximated by figuring the current rate of interest on the selling price as shown by sales records, together with allowances for depth and corner influence according to methods which will be discussed later. If accurate results are desired, recourse may be had to a computation of surplus income as illustrated earlier in this chapter. The present land rental being ascertained it is a simple matter to apply the line K C thereto and in this way determine the line C D which represents the rent of the land in n years hence. These values may readily be tabulated for the use of the assessors in a form something like the following:

TABLE III

FUTURE LAND RENTS FOR VARIOUS PRESENT RENTS AND DIFFERENT TERMS OF YEARS

Present Annual Rental Value of Land.	Number of Years Before Replacement of Building. n									
	1	2	3	4	5	6	7	8	9	10
$1,000	$1,040	$1,080	$1,120	$1,160	$1,200	$1,240	$1,280	$1,320	$1,360	$1,400
2,000	2,080	2,160	2,240	2,320	2,400	2,480	2,560	2,640	2,720	2,800
3,000	3,120	3,240	3,360	3,480	3,600	3,720	3,840	3,960	4,080	4,200
4,000	4,160	4,320	4,480	4,640	4,800	4,960	5,120	5,280	5,440	5,600
5,000	5,200	5,400	5,600	5,800	6,000	6,200	6,400	6,600	6,800	7,000
6,000	6,240	6,480	6,720	6,960	7,200	7,440	7,680	7,920	8,160	8,400
7,000	7,280	7,560	7,840	8,120	8,400	8,680	8,960	9,240	9,520	9,800
8,000	8,320	8,640	8,960	9,280	9,600	9,920	10,240	10,560	10,880	11,200
9,000	9,360	9,720	10,080	10,440	10,800	11,160	11,520	11,880	12,240	12,600
10,000	10,400	10,800	11,200	11,600	12,000	12,400	12,800	13,200	13,600	14,000

Note.—The above table is based on an annual increase in land rentals of 4 per cent.

Having fixed upon values for f and n, the next step is to proceed to the computation of the value of the building and land for assessment purposes. In this computation, it is unnecessary to differentiate between the net rental of the land and that of the building. We shall first take the case in which the net rentals decrease with the passage of time. In such instances the income may be considered as a steadily diminishing annuity terminating at the date when the present building is abandoned. The total future income, therefore, may be considered as forming a figure like A B C D. For purposes of computation, it seems best to divide the quadrangle A B C D into the rectangle A E C D and the triangle B E C.

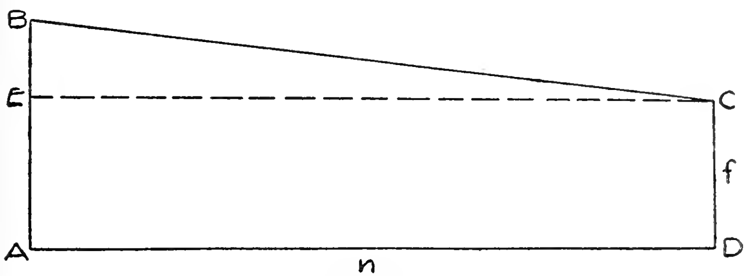

FIGURE 3

If p+f=A B=present net rental,

f=C D=net rental of land at date of replacement of building,

n=A D=future life of building in years,

r=current rate of interest,

A=present date,

D=date of replacement,

Then, the annual decrease in rental $= \frac{p}{n}$

If rent is paid in advance, the present value of the first year's rent would be p + f.

The present value of the second year's rent would be

$$\frac{f}{1+r} + \frac{p - \frac{p}{n}}{1+r} = \frac{f}{1+r} + \frac{p(n-1)}{n(1+r)}$$

Multiplying both numerator and denominator of the last term by $(1+r)^{n-1}$, the result becomes

$$\frac{f}{1+r}+\frac{p(n-1)(1+r)^{n-1}}{n(1+r)(1+r)^{n-1}}=\frac{f}{1+r}+\frac{p(n-1)(1+r)^{n-1}}{n(1+r)^{n}}$$

The present value of the third year's rent would similarly amount to

$$\frac{f}{(1+r)^2}+\frac{p-\frac{2p}{n}}{(1+r)^2}=\frac{f}{(1+r)^2}+\frac{p(n-2)}{n(1+r)^2}=\frac{f}{(1+r)^2}+$$

$$\frac{p(n-2)(1+r)^{n-2}}{n(1+r)^2(1+r)^{n-2}}=\frac{f}{(1+r)^2}+\frac{p(n-2)(1+r)^{n-2}}{n(1+r)^{n}}$$

Similarly we obtain for the present value of the fourth year's rent

$$\frac{f}{(1+r)^3}+\frac{p(n-3)(1+r)^{n-3}}{n(1+r)^{n}}$$

To obtain the present value of the total income from the existing building we must summate the separate annual rentals for the entire n years. The sum of the first terms is simply the present value of an annuity for n years and may be obtained for any given rate of interest from almost any book of insurance tables. We shall designate this sum by the letter F.

The values of annuities of varying amounts, the rate of interest being 5 per cent and the first payment being made at the beginning of the year, are shown in the following table:

TABLE IV

VALUES OF F. PRESENT VALUES OF TERMINABLE ANNUITIES

Annual Payment in Dollars. f	Duration of Annuity in Years n									
	1	2	3	4	5	6	7	8	9	10
$1,000	$1,000	$1,952	$2,859	$3,723	$4,546	$5,329	$6,076	$6,786	$7,463	$8,108
2,000	2,000	3,905	5,719	7,446	9,092	10,659	12,158	13,573	14,927	16,217
3,000	3,000	5,858	8,580	11,172	13,639	15,990	18,229	20,361	22,392	24,327
4,000	4,000	7,810	11,439	14,894	18,185	21,318	24,304	27,148	29,853	32,433
5,000	5,000	9,764	14,298	18,618	22,730	26,649	30,380	33,935	37,320	40,541
6,000	6,000	11,716	17,158	22,341	27,276	31,980	36,458	40,722	44,783	48,650
7,000	7,000	13,669	20,018	26,063	31,823	37,305	42,531	47,509	52,246	56,752
8,000	8,000	15,620	22,878	29,790	36,369	42,638	48,008	54,292	59,709	64,865
9,000	9,000	17,576	25,739	33,512	40,915	47,970	54,685	61,084	67,179	72,980
10,000	10,000	19,524	28,594	37,232	45,459	53,295	60,757	67,864	74,632	81,078

Note.—Computations for this table were made by the slide rule, hence the last digit is only an approximation.

Tables may, of course, be constructed for every conceivable value of f or the quantity f may be subdivided into its components and the sum of the parts obtained as, for instance, if f equals $24,320 and n equals 6, the process would be as follows:

f	F
$20,000	$106,590
4,000	21,318
300	1,599
20	107
$24,320	$129,614

In this way, the construction of a multiplicity of tables may be avoided. The process of obtaining the sum of the second terms, which sum we shall designate as P, is as follows:

$$P = p + \frac{p(n-1)(1+r)^{n-1}}{n(1+r)^n} + \frac{p(n-2)(1+r)^{n-2}}{n(1+r)^n} + \frac{p(n-3)(1+r)^{n-3}}{n(1+r)^n}$$

$$- - - - - - - + \frac{p[n-(n-1)][1+r]^{n-(n-1)}}{n(1+r)^n}$$

$$= p\left[1 + \frac{(n-1)(1+r)^{n-1} + (n-2)(1+r)^{n-2} + (n-3)(1+r)^{n-3} - - +(1+r)}{n(1+r)^n}\right]$$

If we call the second factor in this quantity Q, then

P=p Q. By substitution for r in the formula, the numerical value of Q for various terms of years is easily ascertained.

Let $r = .05$

Then, if $n = 1$,

$Q = 1.$

If $n = 2$,

$$Q = 1 + \frac{(2-1)(1+.05)^1}{2(1+.05)^2} = 1 + \frac{1\ 05}{2(1+.05)^2} = 1.476$$

If $n = 3$,

$$Q = 1 + \frac{(3-1)(1+.05)^{3-1} + (3-2)(1+.05)^{3-2}}{3(1+.05)^3}$$

$$= 1 + \frac{2(1.05)^2 + 1.05}{3(1.05)^3} = 1.937$$

If $n = 4$,

$$Q = 1 + \frac{3(1.05)^3 + 2(1.05)^2 + (1.05)}{4(1.05)^4} = 2.3837$$

Similarly if $n = 5$,

$$Q = 1 + \frac{4(1.05)^4 + 3(1.05)^3 + 2(1.05)^2 + (1.05)}{5(1.05)^5} = 2.8160 \text{ etc.}$$

In this way, values of Q can be computed for all values of n and a table something like the following may be constructed showing the values of Q and P at a glance.

TABLE V

VALUES OF P. PRESENT WORTH OF DIMINISHING ANNUITY

	Duration of Period in Years. n									
	1	2	3	4	5	6	7	8	9	10
Values of Q.	1.0000	1.4761	1.9372	2.3837	2.8160	3.2348	3.6410	4.0340	4.4147	4.7841
Values of P.	Values of P.									
$1,000	$1,000	$1,476	$1,937	$2,384	$2,816	$3,235	$3,641	$4,034	$4,415	$4,784
2,000	2,000	2,952	3,874	4,767	5,632	6,469	7,282	8,068	8,828	9,568
3,000	3,000	4,428	5,811	7,152	8,448	9,704	10,922	12,102	13,242	14,352
4,000	4,000	5,904	7,748	9,535	11,263	12,939	14,563	16,135	17,657	19,136
5,000	5,000	7,380	9,686	11,919	14,079	16,172	18,205	20,169	22,071	23,919
6,000	6,000	8,856	11,622	14,303	16,896	19,409	21,815	24,203	26,486	28,702
7,000	7,000	10,332	13,558	16,687	19,711	22,641	25,486	28,234	30,900	33,486
8,000	8,000	11,807	15,496	19,071	22,527	25,875	29,125	32,270	35,312	38,272
9,000	9,000	13,286	17,434	21,455	25,345	29,115	32,768	36,307	39,729	43,053
10,000	10,000	14,761	19,372	23,837	28,160	32,348	36,410	40,340	44,147	47,841

NOTE. Rate of interest 5 per cent per annum. Annual payment to be madeat beginning of year. Calculations for this table are made by slide rule, hence the last digit is only approximate.

It was previously stated that, in some cities, the density of population may be increasing so rapidly that, despite the deterioration of the buildings, the rentals thereof may actually be increasing from year to year. Yet, even in such cases, the time will arrive when still greater income could be secured by erecting a more up-to-date building on the site and hence, as in the preceding case, the present building will become unprofitable and it will be consigned to the dump.

Such instances, however, obviously require a different formula for capitalization of rentals. The diagram of future income would now appear as follows: It will be noted that in each case, f equals the minimum and p+f the maximum rental expected in the future, while p equals the difference between these extremes.

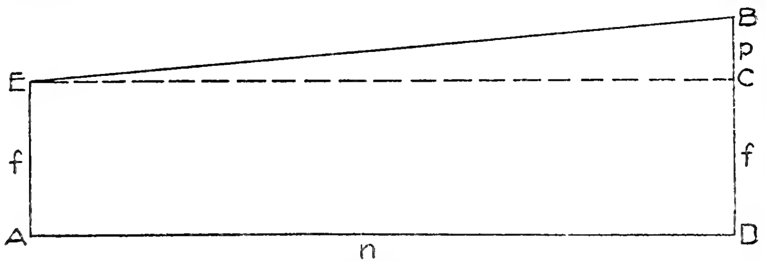

FIGURE 4

If $f = CD$ = present net rental,

$p+f = BD$ = net rental at date of replacement,

= land rent at that date,

$n = AD$ = future life of building in years,

r = current rate of interest,

A = present date,

D = date of replacement,

Then the net increase in rental per annum $= \frac{p}{n}$

If rentals are paid in advance, the present value of the rent for the first year will equal f. The present value of the rent for the second year will be

$$\frac{f}{1+r} + \frac{\frac{p}{n}}{1+r} = \frac{f}{1+r} + \frac{p}{n(1+r)} = \frac{f}{1+r} + \frac{p(1+r)^{n-2}}{n(1+r)^{n-1}}$$

The present value of the rent for the third year will amount to

$$\frac{f}{(1+r)^2}+\frac{\frac{2p}{n}}{(1+r)^2}=\frac{f}{(1+r)^2}+\frac{2p}{n(1+r)^2}=\frac{f}{(1+r)^2}+\frac{2p(1+r)^{n-3}}{n(1+r)^{n-1}}$$

Similarly, the present value of the rent for the fourth year will be expressed by

$$\frac{f}{(1+r)^3}+\frac{3p(1+r)^{n-4}}{n(1+r)^{n-1}}$$

As in the previous case, to find the present value of the income for n years we must summate the values for the separate years. The sum of the first terms, F, as in the preceding instances, is equal to the present value, discounted at the proper rate of interest, of a terminable annuity of f dollars for n years and may be found in any table of annuities such as the one already cited in this chapter.

The sum of the second terms or P is as follows:

$$P=p\,\frac{0+(1+r)^{n-2}+2(1+r)^{n-3}+3(1+r)^{n-4}-----+(n-1)(1+r)^{n-n}}{n(1+r)^{n-1}}$$

$$=p\,\frac{(1+r)^{n-2}+2(1+r)^{n-3}+3(1+r)^{n-4}-------+(n-1)}{n(1+r)^{n-1}}$$

If, again, we let the second factor equal Q, then, as before, P=p Q.

Values of Q may be thus readily computed for any number of years at any interest rate. Assuming 5 per cent as the current rate, then, by substitution, we would find the values of Q for different periods as in the following illustration.

If n = 1. Q = 0

If n = 2.

$$Q=\frac{(1.05)^0}{2(1.05)^1}=\frac{1}{2(1.05)}=\frac{1}{2.10}=.476$$

If n = 3,

$$Q=\frac{(1.05)^1+2(1.05)^0}{3(1.05)^2}=\frac{1.05+2}{3(1.05)^2}=.619$$

If n = 4,

$$Q=\frac{(1.05)^2+2(1.05)+3}{4(1.05)^3}=1.339.$$

If n = 5,

$$Q=\frac{(1.05)^3+2(1.05)^2+3(1.05)+4}{5(1.05)^4}=2.161$$

These values of Q may, for various values of p, be tabulated in a form something like the following, thus giving directly the values of P for different values of p.

TABLE VI

VALUES OF P. WHEN RENTS ARE INCREASING

	Number of Years Building Will Yet Staud. n									
	1	2	3	4	5	6	7	8	9	10
Values of Q.	0	.4762	.9222	1.3396	1.7298	2.0945	2.4349	2.7523	3.0449	3.3247
Values of p.	Values of P.									
$1,000	0	$476	$922	$1,340	$1,730	$2,094	$2,435	$2,752	$3,045	$3,325
2,000	0	952	1,844	2,679	3,460	4,189	4,869	5,508	6,089	6,649
3,000	0	1,428	2,766	4,019	5,189	6,287	7,304	8,257	9,134	9,974
4,000	0	1,904	3,688	5,358	6,920	8,378	9,738	11,009	12,178	13,298
5,000	0	2,380	4,611	6,698	8,649	10,472	12,173	13,761	15,222	16,622
6,000	0	2,856	5,553	8,038	10,380	12,567	14,608	16,512	18,267	19,946
7,000	0	3,332	6,455	9,376	12,110	14,661	17,041	19,267	21,310	23,271
8,000	0	3,808	7,377	10,717	13,840	16,755	19,477	22,018	24,355	26,596
9,000	0	4,284	8,299	12,056	15,570	18,850	21,912	24,770	27,399	29,920
10,000	0	4,762	9,222	13,396	17,298	20,945	24,349	27,523	30,449	33,247

Note.—Payments to be made at beginning of year. Rate of interest 5 per cent. Calculations for this table were made by slide rule, hence the last digit is only an approximation.

In all of the preceding computations of p, it has been assumed that rentals will increase or decrease at a constant rate. As was previously explained, such, of course, is almost never the case in the actual history of a building. The movement is not simple and regular but considerable changes are likely to occur at irregular intervals. If the actual net rentals are graphed in a historigram and the irregularities are smoothed out, it may be found that a curve rather than a straight line is the usual result. If experiment proves such to be the case, the method of obtaining the summation of the second terms, or Q, would be necessarily somewhat different and all the values of Q would be changed. In practice, however, p is likely to be quite small as compared to f and the ratio of P to F will be a still smaller quantity. This being true, the error involved in considering the rental historigram to be a straight line is likely, in the majority of cases, to be so small as to be negligible. If experience proves that this assumption is untenable, the normal shape of the historigram of rent should be studied out for each and every ordinary type of building and values of P computed from the curves thus obtained.

We have now found the method of computing the present value of the property derived from the future income of the present building. The land will, however, still have value after the present building is removed.

Since land usually yields a permanent income, its value at the close of the period will equal approximately the rent C D (indicated in figures 1 and 2) capitalized at the current rate of interest and discounted back to the present date at the same rate of interest. This operation assumes a constant rate of interest which assumption is likely to be approximately true since interest rates change very slowly. If, for example, the rent of a plot of ground n years hence was expected to be $400, and the rate of interest is assumed to be 5 per cent, the approximate value of the ground n years from now would be 400÷.05 or $8,000. If n equals 20 years, this sum discounted at 5 per cent to the present date amounts to $3,013.

A table may readily be constructed showing the present worths of different values of C D for various periods.

Such a table is given below, L being used to represent the present worth of the land value n years hence.

TABLE VII

VALUES OF L OR PRESENT WORTH OF LAND FOR VARIOUS VALUES OF C D.

Net Rental n years hence C D.	Length of Period in Years. n									
	1	2	3	4	5	6	7	8	9	10
$100	$1,905	$1,814	$1,728	$1,645	$1,567	$1,492	$1,421	$1,354	$1,289	$1,228
200	3,809	3,628	3,455	3,291	3,134	2,985	2,843	2,707	2,578	2,455
300	5,714	5,442	5,183	4,936	4,701	4,478	4,265	4,061	3,868	3,683
400	7,618	7,256	6,911	6,582	6,268	5,970	5,686	5,414	5,157	4,911
500	9,524	9,070	8,638	8,227	7,835	7,462	7,107	6,768	6,446	6,139
600	11,429	10,885	10,367	9,872	9,402	8,955	8,529	8,122	7,735	7,366
700	13,332	12,699	12,094	11,520	10,970	10,448	9,950	9,475	9,024	8,594
800	15,236	14,513	13,822	13,163	12,536	11,940	11,372	10,830	10,314	9,822
900	17,141	16,327	15,550	14,810	14,105	13,433	12,795	12,184	11,604	11,050
1,000	19,048	18,141	17,277	16,454	15,671	14,924	14,214	13,537	12,892	12,278

Note.—Computations made by the slide rule and last figure only an approximation. Based on Table 20 in Watson, Jas. C., "*Tables for Interest and Discount.*"

The present land value is ordinarily most easily found by a study of sales records but may be computed from a study of rents if sufficiently accurate data are at hand. In most cases, the first method is the practical one. If we designate the present land value by A, the total value of land and building by V, and the value of the building alone by B, we are now in a position to derive the last mentioned quantity. We shall assume V, F, P, L, and A as known.

Then $V=F+P+L$

Also $V=A+B$

$\therefore \quad B=V-A$

and $B=F+P+L-A$

Having determined the value of the bare land from sales records and being equipped with complete tables similar in nature to the ones heretofore given, the assessor is now in a position to compute the actual value of the building as distinguished from the land. For this purpose, a schedule something like the following is necessary:

Net Rental	\$400
Minimum Future Net Rental Expected = f	300
Maximum Future Change in Net Rental Expected = p	100
Expected Life of Building = n	8
Present Worth of $\Sigma f = F$	2,036
Present Worth of $\Sigma p = P$	403
Anticipated Rent of Land n Years Hence	200
Present Worth of Land Value n Years Hence = L	\$2,707
Present Land Value = A	1,832
Estimated Value of Bldg. = F + P + L − A = B	2,314

E. Depreciation Curve

In many states, the law requires that land and buildings be valued separately and it may be that they are taxed at different rates. In such cases, it is quite essential that the differentiation be made as accurately as possible.

The value of a new building is ordinarily equal approximately to its cost of construction. This cost of construction may usually be estimated with a fair degree of accuracy and frequently the actual figures may be available. A given type of building in a given location has a definite normal life. This life may be considerably lengthened by proper care and greatly shortened by neglect but, for the first few years, at least, the chances are that

it will not vary far from the normal rate of deterioration. As the building deteriorates or becomes unsuited to its location, that part of the rent ascribable to the building alone tends to decrease and will, as has been shown, eventually reach zero. This diminishing flow of income is indicated by the triangles BCK in figures 1 and 2.

The assessor will usually be saved much labor if the complete computation of the value of the building is made only once in a considerable period of time, and, during the interval of perhaps fifty years, the depreciation in value is assumed to go on at a normal rate. By this method, it is only necessary to multiply the value determined upon at the beginning of a period by the proper factor in order to arrive at the assessed value for any given date. The next necessary device, then, is a scale of depreciation based on the anticipated life of the building. A different curve would be necessary for each different period of life anticipated for a building.

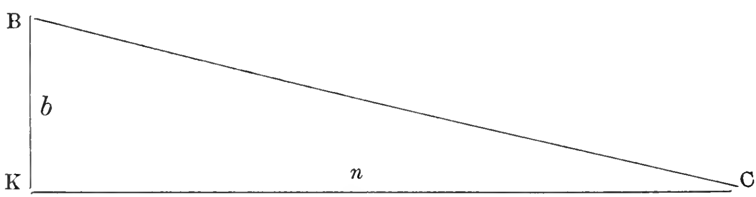

FIGURE 5.

In the above figure, let n equal the expected future life of the building, b equal the present net income, and r equal the amount of one dollar for one year at the current rate of interest. As in previous problems, let us assume the rent paid at the beginning of the year. Starting at the close of the period and working backward, we get the following results.

The value at the end of n years equals zero.

The value at the close of n—1 years equals $\frac{b}{n} = \frac{\frac{b}{n}}{1} = \frac{\frac{b}{n}}{r^0}$

At the close of n—2 years, the value is

$$1 + \frac{\frac{b}{n}}{r} = \frac{2b}{nr^0} + \frac{b}{nr} + \frac{2br^n}{nr^0r^n} + \frac{br^{n-1}}{nrr^{n-1}} = \frac{2br^n}{nr^n} + \frac{br^{n-1}}{nr^n} = \frac{b}{nr^n}(2r^n + r^{n-1})$$

At the beginning of n — 3 years, the value becomes $\frac{3b}{n} + \frac{\frac{2b}{n}}{r} + \frac{\frac{b}{n}}{r^2} =$

$$\frac{3b}{nr^0} + \frac{2b}{nr} + \frac{b}{nr^2} = \frac{2br^{n-1}}{nrr^{n-1}} + \frac{br^{n-2}}{nr^2r^{n-2}}$$

$$= \frac{3br^n}{nr^n} + \frac{2br^{n-1}}{nr^n} + \frac{br^{n-2}}{nr^n} = \frac{b}{nr^n}(3r^n + 2r^{n-1} + r^{n-2})$$

Similarly, at the end of n—4 years, the value would be expressed by $\frac{b}{nr^n}$ $(4r^n + 3r^{n-1} + 2r^{n-2} + r^{n-3})$ and, at the end of n—n years or, in other words, at the beginning of the period, the value would amount to

$$\frac{b}{nr^n}\left\{ nr^n + [n-1]r^{n-1} + [n-2]r^{n-2} + \ldots . [n-(n-1)]r^{n-(n-1)} \right\}$$

With this mathematical basis, we can proceed to the derivation of a curve of depreciation for buildings of any estimated length of life.

Suppose, for example, that the life of the building is estimated at ten years.

Then $n=10$

The percentage of cost value remaining in a building at any date is obtained by dividing its value at that date by its cost. At the beginning of the period, the value of the building and its cost would be identical. Substituting in the above formula for both numerator and denominator, we get

$$\frac{\frac{b}{10r^{10}}(10r^{10} + 9r^9 + 8r^8 + 7r^7 + 6r^6 + 5r^5 + 4r^4 + 3r^3 + 2r^2 + r)}{\frac{b}{10r^{10}}(10r^{10} + 9r^9 + 9r^8 + 7r^7 + 6r^6 + 5r^5 + 4r^4 + 3r^3 + 2r^2 + r)}$$ which equals

unity. The first factors of numerator and denominator cancel each other in every case and, at the end of a year, the percentage of the original value is equal to the expression

$$\frac{9r^9 + 8r^8 + 7r^7 + 6r^6 + 5r^5 + 4r^4 + 3r^3 + 2r^2 + r}{10r^{10} + 9r^9 + 8r^8 + 7r^7 + 6r^6 + 5r^5 + 4r^4 + 3r^3 + 2r^2 + r}.$$ At the end of two

years, the percentage of the original value is equal to

$$\frac{8r^8 + 7r^7 + 6r^6 + 5r^5 + 4r^4 + 3r^3 + 2r^2 + r}{10r^{10} + 9r^9 + 8r^8 + 7r^7 + 6r^6 + 5r^5 + 4r^4 + 3r^3 + 2r^2 + r}$$ etc.

The results may be tabulated as follows for the use of the assessor.

TABLE VIII

NORMAL PERCENTAGE OF ORIGINAL VALUE REMAINING IN BUILDINGS HAVING A LIFE OF TEN YEARS, GIVEN AT THE END OF EACH YEAR AFTER VALUATION

Number of years since original valuation.	Percentage of original value remaining.	Percentage decrease in value.
1	79.10	20.90
2	61.18	17.92
3	46.02	15.16
4	33.38	12.64
5	23.06	10.32
6	14.87	8.19
7	8.63	6.24
8	4.18	4.45
9	1.35	2.73

Note.—Rate of interest used in calculation of percentages is 5 per cent.

F. Assessor's Schedules

In the preceding pages, a set of tables has been sketched out which indicates in a general way the character of the data which should be completely worked out for the convenience and guidance of the assessors. The following schedules correspond with the plan of assessment outlined. The land value schedule anticipates the discussion in a later chapter but is introduced here in order to have all the forms together. For each piece of land, there should be a *general* schedule, a *land* schedule, a *building* schedule for *each* building thereon and, in some cases, a separate sheet for each valuable machine or engine contained in the building. These schedules are so arranged as to suffice for a number of years. They are all connected by the index number located in the upper right hand corner of each.

The schedules are on separate sheets and fit into a loose-leaf binder. Different kinds of schedules may be printed on different colored papers if desired. Plats of the same size may be constructed and placed in the same covers with the schedules. By using loose leaves, the assessor need carry no bulky port-

folios and yet complete records may be secured and preserved for future reference.

A system of this kind enables the Tax Department to keep at hand a continuous record from year to year for each plot of land. Improvements are recorded as made and depreciation and destruction are also indicated. This system of record is largely the invention of Mr. R. E. Goodell and was devised by him for the use of the Tax Department of the City of Milwaukee.

ASSESSOR'S SCHEDULES

GENERAL SCHEDULE

All / ~~Part~~ of Lot *7* Block *16* Ward *12* Index No. *L 14 m 7*
in Warner's replat of Johnson's Second Addition..................

....Sec. *4* TP *22* R *36* W

Location *West* Side *Main* ~~Ave.~~ / St.

Between *Locust* ~~Ave.~~ / St. and *Euclid* Ave. / ~~St.~~

~~Inside~~ / Corner Lot

Character of Location

Nature of District, *retail*...........
Depth of Building Strip in ft. *120*

Street:
- ~~Unpaved~~ / Paved... *Brick 1910*.....
- Sewer.... *12 inch 1900*....
- Gas...... *1904*...........
- Water....*1892*............
- Miscellaneous .. *Wire conduit 1911*....................

Alley:
- Open *Yes*........
- ~~Blind~~
- Graded *Yes*........
- Paved *Brick, 1910.*
- Width *16 ft*.......

	1912	1913	1914	1915	1916
No. of buildings........	*1*	*1. Building replaced*			
Owner's estimate of total value......... ..	*$12,000*	*$32,000*	... .	....	....
Transfers:					
Consideration — recorded	*$1*	....	....	....	....
Consideration — actual	*$16,000*	....	....	....	....
Consideration — inf'rm'nt	*J. K. Jones*				
Change in building values during year....	....	*$24,680*	....	....	....
Change in land values during year	....	*$1,880*	....	....	....
Total value buildings ..	*$420*	*$25,000*	....	....	....
Total value land..	*$14,200*	*$16,080*	....	....	....
Total value land and buildings............	....	*$41,080*	....	....	....

ASSESSOR'S SCHEDULE

LAND SCHEDULE

Index No. *L 14 m 7*

Principal frontage on *Main* ~~Ave.~~ St. *50* ft:

Depth therefrom......... *120* ft.

Factor for depth *107.5* per cent

Secondary frontage on *Euclid* Ave. ~~St.~~ *120* ft.

Alley frontage Rear 50 ft. ~~Side~~ —— ~~ft.~~ Alley factor Rear *.067* ~~Side~~ ——

Corner angle *90* degrees

	1912	1913	1914	1915	1916
Unit value principal St.	*210*	*270*	....	....	....
Unit value secondary St.	*140*	*150*	....	....	....
Ratio of values.........	*.667*	*.593*	....	....	....
Corner factor — principal	*52,347*	*46,144*	....	....	....
Corner factor — second'ry	*15,272*	*13,411*	....	....	....
Corner factor — total.....	*67,619*	*59,555*	....	....	....
Corner factors × principal unit ÷ 1,000. ..	*14,200*	*16,080*	....	....	....
Gross land value....... .	*14,200*	*16,080*	....	....	....
Deductions — easements	....	....	....	....	....
Defects in site	....	....	....	....	....
Net land value........ ..	*14,200*	*16,080*	....	....	....

ASSESSOR'S SCHEDULE

BUILDING SCHEDULE

No. *2732* Main { ~~Ave.~~ St. Index No. *L 14 m 7 11*

Date Completed *Jan. 20, 1913*

Owner..*M. J. Carter*......Builder *Jenkins & Smith*.....................

Dimensions by Stories. Basement *50 x 80* 1st *50 x 100*
2nd *50 x 80* Others *50 x 80.*

No. of Stories *4*

Height of Stories — Basement *8* 1st *14* 2nd *10*
3rd *9* 4th *8* 5th — 6th — 7th —

Use of Building—*Store*...

Foundation *Concrete*..

Material of Superstructure *Brick*......................................

Roof *Tar & gravel*...

Interior Finish *Cypress — plaster*......................................

Floors *hardwood*......Heat *steam boiler*................................

Plumbing { Sinks *5* Baths *3* Toilets *4*
Miscellaneous..........Quality *very good*....................

Class *M* Estimated Cost per cu. ft. *11½* cts.

Cu. Contents in ft. *210,000* Estimated Cost *$24,150*

Owner's Estimate of Cost *$22,000*

Builder's Estimate of Cost *$25,000*

Assessor's Final Estimate *$25,000*

	1912	1913	1914	1915	1916
Estimated life of building in years = n.....	*0*	*40*	....	....	....
Present gross rental.....	*$1,200*	*$4,200*	....	....	....
Deductions— Heat......	....	*900*	....	....	....
Light... ..	*200*	*400*	....	....	....
Janitor....	....	....	....	....	....
Repairs. ..	*200*	*100*	....	....	....
Excess....					
Taxes.....	*100*	*300*	....	....	....
Insurance	*20*	*40*	....	....	....
Miscellaneous. .	*60*	*20*	....	....	....
Net rental............ ...	*620*	*2,440*	....	....	....
Minimum future net rental expected = f...	*420*	*2,000*	....	....	....
Maximum change in rental expected = p.....	*0*	*440*	....	....	....
Values from tables					
F......	*620*	*20,160*	....	....	....
P......	*0*	*7,120*	....	....	....
Anticipated rent of land n years hence...... ..	....	*2,000*	....	....	....
Present worth of land value in n years = L	*14,000*	*15,000*	....	....	....
Present land value = A	*14,200*	*16,080*	....	....	....
Estimated value of bldg. F + P + L − A = B..	*420*	*26,200*	....	....	....
Assessed valuation of bldg..................	*420*	*25,000*	....	....	....
Percentage depreciation during year......... ..	*100*	*4*	....	....	....
Depreciation in value during year	*420*	*1,000*	....	....	....

G. Most Profitable Building

In the preceding pages, we have deduced the theory that, under static conditions, an urban lot has its value determined by the present worth of expected rental surpluses, over and above costs, obtainable from buildings generally believed to be of the most profitable type and size erected thereon. We have not, however, discussed the point as to how it is possible to ascertain what is the most profitable type of structure which can be erected on a given lot under a given set of circumstances. On a given lot in the retail district of a city, if he has proper resources and legal restrictions do not prevent, the owner has the option of constructing a building of frame, brick, stone, steel and con-

crete, or a combination of all. He may build it ten feet deep or covering the entire lot or he may build it one story or forty stories high. He may finish the interior in plaster, sheet iron, or marble. Upon what fact or facts will his decision depend?

The current statement is that he is guided by the value of the lot— that a lot of given value requires a building of proportionate cost. Richard M. Hurd says[1] that the value of the building should approximate that of the lot. But we have seen that the value of the building with the lot is wholly dependent upon the capitalization of the present and future rentals of the building. Evidently, then, it is to these rentals that we must look for a solution of the problem at issue.

If the building occupies a narrow strip along the sidewalk space, the cost per square foot of floor space will be slightly greater than if the building has a greater depth, since less wall proportionately is needed in the latter case. Again, it is usually true that a two-story building fifty feet deep will cost considerably less than a one-story building 100 feet deep owing to less roof area being required for the two-story structure. For these reasons, there is frequently a decreasing cost of construction as the floor area increases until the building attains a certain size. Thereafter, however, the cost per unit of floor space will rise steadily, if not with absolute regularity, until the limit of constructive possibility is attained. This is true, because, for the higher building, during the process of construction, more scaffolding is required and material must be elevated further; besides, more massive foundations and walls are essential as the building mounts skyward and, as buildings become very high, a constantly increasing percentage of space must be utilized for elevator and air shafts, stairways, etc. At the same time, however, the rental per square foot will diminish, for the ground floor usually possesses much the highest utility and the floors far above the street are often considered less desirable though, in some cases, the reverse is true because the upper floors are further removed from the dust and noise of the street.

At any rate, the building will be extended upward until the margin is reached at which the additional net rentals, over and above depreciation, will just pay interest on the investment. If

(1) Hurd, Richard M., *Principles of City Land Values*, p. 97.

the higher floors are considered less desirable, this margin will be reached sooner than in those cases in which they are considered equally desirable with the lower floors.

In the former case, two forces, the increasing cost and the decreasing rentals will both tend to keep the marginal floor at a low altitude while, in the latter case, the increasing cost of construction will be the important factor acting in that direction. This will normally be supplemented by slightly increased elevator costs since the service to the upper floors is relatively more expensive than that to the lower floors.

But the lot owner must decide not only on the size of building but also on the quality most profitable to construct. As the building is made more comfortable and attractive, the rental per square foot of floor space will increase but a building of double cost will seldom bring in double the rent of the cheaper building and it will never do so when the cost is increased beyond a certain limit. The law of diminishing returns applies here just as in regard to the altitude of the structure. The first improvements installed will yield a surplus but this surplus will diminish as additional units of capital are invested until it finally entirely disappears. It will pay to add improvements, then, until the net increase of rental due to the last dollar invested will just cover the additional depreciation and pay interest on the dollar.

We thus see that the law of diminishing returns operates both in respect to the size and the quality of the building but still other factors complicate the question as to what style of building will be most profitable at a given location. The most important of these is the probability as to future changes in the character and extent of the demand for building services at that location. If a building is located in the center of a retail district in a rapidly growing city, the chances are that building services will, during the next few years, rapidly advance in value. If this is the case, a two-story building, which would produce the maximum net income under present circumstances, might in five years be yielding but a fraction of the net revenue which a five-story building would secure at the same location. A new structure adequate to this enlarged demand would entail the destruction and practically the total loss of the original

building. Therefore, it would be more profitable to build the five-story block today even if the immediate income failed to yield much profit.

Similarly, in a new town, a cheap frame building may show greatest present profit but, in five years, it would be totally unsuited to its location, hence a brick block would, in the long run, yield larger returns even though involving present loss.

It must be kept in mind that the life of the better quality of building is much longer, hence the income will continue longer also and the present worth thereof will obviously be enhanced. Also, the fact that the better building lasts longer enables it to secure a constantly increasing share of the future increment in rentals for, in a growing city, rentals are likely to increase constantly during the period covered by the life of the structure. In five years, the increment in rentals might be only ten per cent but in fifty years it might be 100 per cent. The conclusion, then, must be that, in a thriving city, it will be advisable to build a much larger and a much higher grade building than would be the case in a city of stationary population.

The most profitable type of construction would also be affected by the probability of a future shift in the character of business conducted at that location. If the wholesale district is encroaching on the retail district and its boundary bids fair to pass the given lot within the course, say, of ten years, it would evidently be best to build a cheap structure which would produce the maximum present revenue with the intention of removing it when the new demand arrived.

Evidently, however, all questions of the future may be resolved into an estimate of the present discounted value of all future rentals. This includes all questions regarding growth in population, length of life of building, and change in site use.

The following graphs illustrate a method of approximating the proper kind of building to erect after all estimates, present and future, have been made. Figure 6 shows the manner of deciding upon the proper number of stories to be erected. In Case I, the rents so diminish that the addition of a ninth story would mean a loss, hence only eight stories will probably be constructed. In Case II, however, the present worth of future anticipated rentals is so much greater that it will be profitable

to send the building up to eleven stories. It should be noted that the principal determining factor as to the height of the building is the present worth of all anticipated future rentals. This quantity is affected both by the height of the rent level at

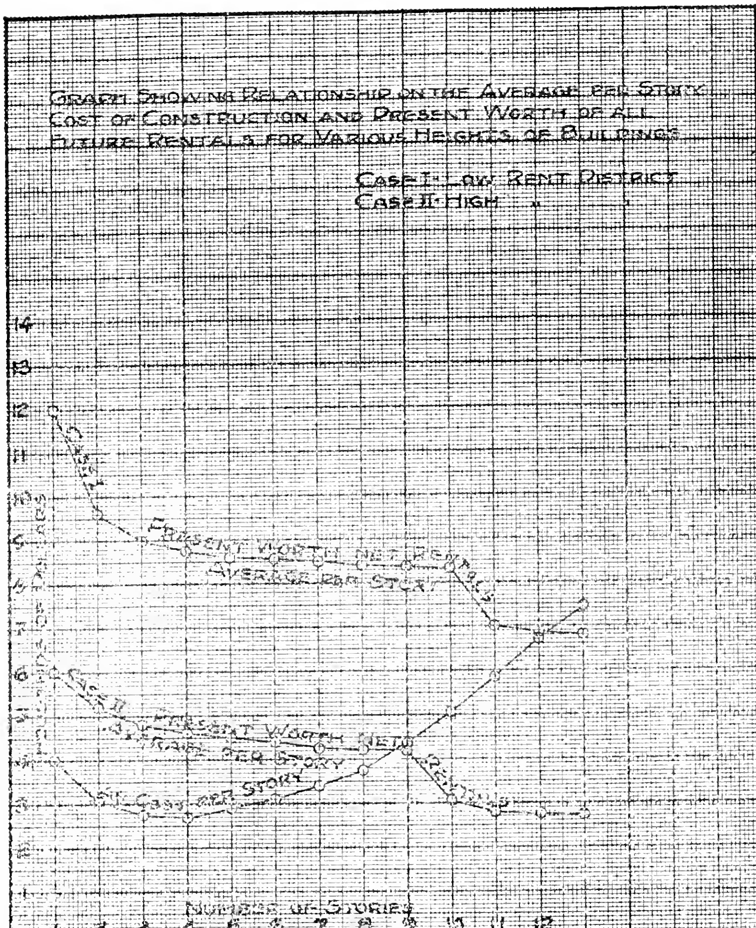

FIGURE 6

present and future changes in the rent level. Either high present rents or rapidly increasing rents will warrant the construction of a high building for, in each case, the results are identical—the present worth of future anticipated rentals is in-

creased and the point of intersection with the cost curve is therefore moved further to the right.

Figure 7 shows the method of determining the fact as to how elaborate a structure a certain location will justify. This fig-

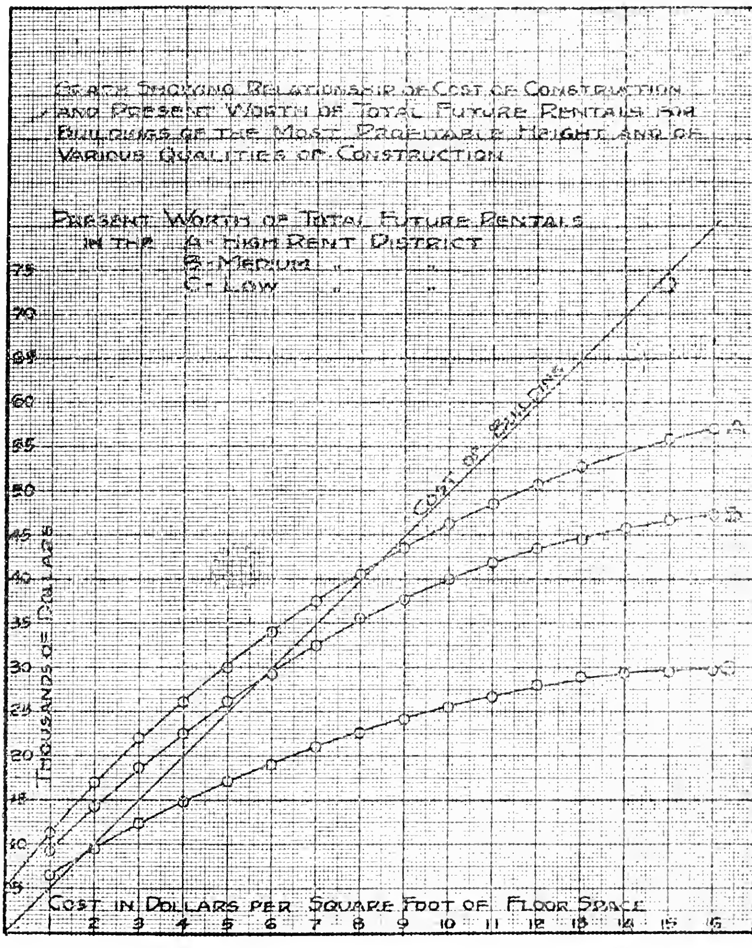

FIGURE 7

ure presupposes that the proper height and size have already been correctly decided upon. In this case, the building cost becomes a straight line while the present worths of various grades of structures resolve themselves into convex curves. The higher

the rent level in the district and the more rapid increase in rentals expected, the higher the present worth curve is elevated and the more it is deflected from the horizontal. As a result, the intersection with the cost line is pushed further to the right indicating that the location demands a building of more expensive quality.

When once it has been decided as to just what type of building is most profitable to erect, we are in a position to proceed to the computation of the value of the land itself.

CHAPTER III

THE SCALE OF UNIT VALUES

A. The Unit System*

In the valuation of land for assessment, it is essential that some standard unit of area be adopted. If this is not done, there can be no comparison of values in different sections of the city and one of the primary objects of a scientific system of assessment is sacrificed. The unit best suited to the needs of one city might be poorly adapted to another. It is the practice to choose as a unit a strip of land having one foot of street frontage and running back at right angles to the street to the depth of the customary lot in the city. If no customary depth of lot exists, the best unit is a strip one foot wide and one hundred feet deep with no alley frontage. The value of such a unit of land is known as the "unit value". Land values in all parts of the city are reduced to a unit basis before making any comparisons. Since different depth curves are necessary for different classes of land, it is perfectly feasible to use a different unit in the residence section from that employed for the business district. This is advisable only in case that the lots

*The system of assessing land according to classes based on use and income and not according to individual ownership is not a new one. According to L. Schmit's article in *La Grande Encyclopedie*, Vol. VIII, p. 677, the cadastre system in its modern form was established by the French Assembly in 1793. The survey was finally completed in 1850. Under this plan, a committee of local land owners classifies each piece of land according to its use, nature, and income. This classification is revised by the municipal council and then posted for fifteen days in a public place. Protests are heard and considered and the finally revised lists are forwarded to the Departmental Commission for approval. From these lists, the Director of Assessments makes the final assessment—land and buildings being assessed separately. All land in the same class is assessed at the same rate per hectare. Reclassification is left to the option of the communes and, owing to opposition from adversely affected land owners, occurs in most cases rarely if at all. Hence, much of the land is today far from equitably taxed.

in the business quarter are principally of one fixed length and those in the residence section of another definite length. In most cities, such a large percentage of lots are of irregular lengths that it is best simply to use the hundred foot strip as a unit throughout the city. This also avoids complications when city growth or shift changes the classification of a given piece of ground.

B. Gradation of Urban Lands

The unit having been decided upon, the next problem is to determine the correct unit values for each side of each block in the city. The preliminary work in this line must be done by the City Board of Assessors acting together. The best results can probably be obtained by first approaching as closely as possible to a correct determination of the unit values surrounding the value summits of the city. In some cities, only one such value summit will exist while, in others, there may be a multiplicity of such summits. The assessors now proceed to fix the unit value of the land at the least valuable point on each side of each city block located in the immediate vicinity of the value summit.

As stated in a preceding chapter, one method of evaluating land is the derivation of the value from mathematical computations based upon expected future income. The attempted application of this method at once gives rise to an interesting question concerning the exact effect of existing buildings on the value of the land upon which they stand. It was previously shown that land is oft times encumbered with an old building which yields some excess rent over and above what could be obtained for the bare land and hence is too good to destroy. But, even though it is unprofitable to replace the old building, the net income therefrom may evidently be small compared to that received from similar pieces of ground on which up-to-date buildings have been erected. This being the case, writers on the subject have frequently assumed that, in computing the present value of the land, consideration must be given to the character of the buildings there. From their point of view, a lot encumbered by an old building should be assessed at a low figure because it yields but a small income while it is, nevertheless, un-

profitable to remove the building. The fallacy in this position is that it ascribes to the land a quality belonging rightfully to the building. The building has deteriorated but the land has meanwhile probably become more intensely demanded and has increased in value. When the structure was erected, the builder, if wise, anticipated a future decrease in the rentals and therefore in the value of the building proper. The early rentals were large enough to yield considerably more than interest on the cost of construction; hence the owner has already received back the larger part of the money put into the building and has little now invested therein. The land is valuable because of its location and, even though the building thereon is not now a good income producer, this fact is not altered. This point may, perhaps, be made more clear by an illustration.

Suppose the structure were frame and a fire should entirely consume it. The land would evidently now be worth exactly as much as the adjacent lot since it likewise is now ready for a modern building. Did the fire really add something to the value of the land or did it simply destroy the value of the building? When a building goes out of fashion, becomes too small, or unsuited to its location, is it not a fact that the deterioration is in the building rather than in the land itself? It would seem that such is the case and hence that adjacent lots may be legitimately valued according to location without regard to the character of the buildings thereon. At any rate, this is the only method of valuation which appears to have any claim to theoretical correctness and which, at the same time, is feasible in practice.

If, then, we wish to compute the value of land from an income basis, we must study the income of only those pieces of land which are at present occupied by the type of building generally believed to be most profitable for the location. If we add to the present worth of all future net rentals of a new building of this type the present worth of the land value at the date when the building will need to be replaced and deduct from the sum the cost of the building, we should closely approximate the present true value of the site.

Since new buildings exactly adapted to their location are the exception rather than the rule, this method of land valuation is usually involved in greater difficulty than that based on records

of sales of vacant lots. The latter method is, therefore, commonly used wherever such sales records are available. This method consists in studying the actual sales which have taken place and collecting evidence from the real estate agents and landowners in the vicinity, thus obtaining the prevalent subjective or objective exchange values existing in recent periods. If rentals have been changing and no sales of vacant land have occurred recently in the immediate vicinity, the value must either be computed from the rentals by the method mentioned above or adjusted from past sales records proportionally to the changes in the rent of the land. If the last named method is attempted, care must be taken to eliminate the building rental from consideration since *land* values are obviously proportional only to *land* rentals. The method of differentiating between income from building and land was discussed in the last chapter.

After the Board of Assessors has decided upon the correct unit values for the lots at the minimum value points on each side of each block around each of the value summits, it should next outline a skeleton scale of values for the city as a whole—that is—the unit values should be settled upon for all points along the principal streets radiating from the value summits out through the city. The unit value at the lowest value point in the frontage of each city block on each side of each of these streets should be tentatively fixed and the results entered upon a map. Copies of this map should be prepared and handed to each of the assessors. With these values as a basis, each assessor should now proceed to determine tentatively the unit value for the minimum value point in each block face of every city block in his assessment district. Conferences should now be held between the assessors in adjacent districts and such adjustments should be made as are necessary in order to bring the unit values into complete harmony at the intersections of the various streets with the district boundaries and along the streets forming these boundaries*.

* L. Schmit, in *La Grande Encyclopedie*, Vol. VIII, p. 678, states that, in 1807, an attempt was made in France to make the classification of land uniform throughout the various prefectures. The law of 1807 provided for a commission in each sub-prefecture consisting of a delegate from each commune. This commission adjusted the classification for the various communes of the sub-prefecture. The records were then forwarded to the prefect who, with the help of the council of the prefecture, adjusted the classifications for the various

The completion of this preliminary plat will require a careful study on the part of the assessors of all available information as to land sales, prices at which various lots are held and offers which have been refused for lots in the vicinity. In this connection, the knowledge of assessors who have assessed their specific districts for many years will prove highly valuable. In a given retail district of a city, value is largely proportional to the number of passersby and a series of traffic counts made at the same hour in different parts of the district, (these counts being repeated at various hours on different days), may prove of immense assistance in improving the accuracy of the gradation. Only after the unit values throughout the city have been tentatively decided upon and complete maps have been made and printed, should the public be called upon to co-operate in the valuation or criticise the results of the assessors.

Public co-operation is desirable for two reasons. First, it stimulates the assessors to greater activity in an attempt to obtain accuracy and equity in the fixation of the unit-value scale. Second, it interests the tax payers in the question of land taxation, educates the citizens on the subject, and tends to secure a greater degree of confidence in and a more hearty co-operation with the city administration. For these reasons, the tentative unit value map should be published and distributed generally throughout the city. A day or two after the distribution, mass-meetings of the taxpayers of the summit districts should be called to meet in the various neighborhoods on successive nights. At each of these meetings, a prominent officer of the tax department and the assessors of that district and those adjacent should be present to defend the scale which has been drafted. After a complete explanation of the system by some official of the department, criticisms should be called for. One case after another should be taken up and discussed pro and con. After the completion of the discussion of the evidence submitted by both sides, some modification of the scale may be agreed upon by the assessors. Those persons not satisfied with the final decision should

sub-prefectures. In 1818, an attempt was made to extend the principle of adjustment to include the various prefectures of a department but it failed—the law being suspended in 1819. In 1821, all attempts at adjustment—even between communes—were abandoned.

be asked to file with the assessor in writing their protests together with such evidence as they possess supporting their contentions. The assessor may later go over this evidence and make such modifications in the unit scale as he deems warranted thereby.

Public meetings in the summit districts should be followed immediately by similar gatherings in the districts adjacent thereto. After these public hearings have been completed and the evidence reviewed, the board of assessors should again meet and decide upon a final series of unit values for the city. This series of unit values should be entered upon a map and this map should be printed and placed in public places for the inspection of the tax payers. Once decided upon, it should not be altered in any way until the date of the next assessment, unless changes should be ordered by the court after hearing an appeal from the assessment.

The fixation of the unit values nearly completes that part of the assessment of land requiring the exercise of discretion. The remainder of the operation is primarily clerical in its nature and success depends mostly upon ability to use tables correctly and to operate slide rule and adding machine with precision and dispatch. Some discretion is required in making special allowances for defects in the site but this is only necessary in exceptional cases.

CHAPTER IV

THE RELATION OF LOT DEPTH TO VALUE

A. General Relationship

It is a self-evident fact that, in general, the deeper the lot the greater is its value and it is likewise almost as self-evident that while the value increases with depth it does not increase proportionately thereto. Experience in many cities seems, however, to prove that, for a given use of the land, there is an approximately definite mathematical relationship existing between the depth of the lot and the value thereof. If a strip one foot wide and one hundred feet deep is taken as a unit, it is, then, possible to express the value of a similar strip one foot wide, but of a different depth, as a percentage of the unit value. These percentages, if arranged according to depth and plotted as a graph, give a curve commonly known as the depth curve. Many attempts have been made to ascertain accurately the trend of this curve, inductive empirical methods being as a rule employed. The tax departments of London, New York City, Chicago, Baltimore, and Milwaukee have done considerable work along this line and the study made by Mr. W. A. Somers of St. Paul for the use of that city is probably the best known investigation of this nature. Unfortunately, in several instances, the attempt has been made to work out a single curve which is equally applicable to business and residence property alike. Since it is highly improbable that the heterogeneous demands for land in the retail, wholesale, manufacturing, inner residential, and suburban districts gives rise to identical depth curves in each case, the matter of the correct curve has been the subject of a considerable amount of rather hazy, indefinite, and partially fruitless discussion.

The first essential, therefore, of a study of this kind must be

to differentiate clearly between the different uses of land and then proceed to derive a specific curve for each different use. So far as the author is aware, no attempt has been made to classify uses for this purpose further than a division of the city into business and residence districts. It is, however, by no means certain that the depth curve for the wholesale district resembles that for the retail district more closely than it does that for the residence district. In fact, there is some reason to suppose that the reverse is more probably true. Careful investigation alone can make possible any conclusions worth considering.

The first rule used in New York City was that laid down by Judge Hoffman. He ascribed two thirds of the value of a lot one hundred feet in depth to the front fifty feet of the same. This crude method was later modified into the 4—3—2—1 rule. This, interpreted, means, that, when a lot one hundred feet in depth has been divided into four sections, of twenty-five feet each, four tenths of the value is assigned to the section touching the street and three tenths, two tenths, and one tenth, respectively, to the other three sections in order. The Neill and Davies rules, both New York products, are also modeled after the Hoffman rule. It seems that the Milwaukee business rule has also been formed somewhat in imitation of the New York curve. Thus, we see that curves independently derived are few.

The following table shows some of the percentages used for various depths according to the rules adopted by different cities and persons.

TABLE IX

PERCENTAGES OF UNIT VALUE ASSIGNED TO LOTS OF VARIOUS DEPTHS BY DIFFERENT CITY TAX DEPARTMENTS. GENERAL OR BUSINESS DISTRICTS

Depth in Feet.	Percentage of Unit Values.					
	Cleveland[1] Curve.	Chicago.[2]	Neill Rule,[3] (Hoffman)	Milwaukee, 1912.[4]	Harper, Edgar.[5] London.	Davies' Curve,[6] N. Y.
5	14.35	14.9	17	17	23.0	12.5
10	25.00	19.9	26	28	32.0	21.8
15	33.22	25.0	33	37	39.0	29.2
20	41.00	30.1	39	44	45.0	35.8
25	47.90	34.3	44	49	50.0	41.5
30	54.00	39.9	49	54	55.0	47.0
40	64.00	48.8	58	63	63.0	56.7
50	72.50	57.5	67	70	70.5	65.8
60	79.50	67.0	74	77	77.5	73.3
70	85.60	76.0	81	84	83.6	80.5
75	88.30	79.3	84	87	86.6	84.1
80	90.90	84.0	88	90	89.4	87.5
90	95.60	92.2	94	95	95.0	94.1
100	100.00	100.0	100	100	100.0	100.0
110	104.00	108.0	...	103	105.0	106.9
120	107.50	116.0	...	107	109.5	111.1
125	109.05	119.3	112	109	112.6	113.7
140	113.00	131.0	...	113	118.2	121.2
150	115.00	137.5	118	115	122.4	126.1
160	116.80	145.0	...	117	126.4	131.1
175	119.14	154.3	122	119	132.3	138.5
180	119.80	158.0	...	120	134.2	141.2
200	122.00	170.0	125	122	141.4	149.0
250	126.05	...	...	126	158.0	...
300	129.25	...	...	...	...	...
350	131.90	...	...	...	...	...
400	134.20	...	...	...	...	...
450	136.15	...	...	...	...	...
500	137.85	...	...	...	...	...
550	139.30	...	...	...	...	...
600	140.55	...	...	...	...	...
650	141.55	...	...	...	...	...
700	142.35	...	...	...	...	...

[1] *First Quadrennial Report of Board of Assessors of Real Property in Cleveland, Ohio*, p. 14.

[2] Manufacturers' Appraisal Co. Analysis of Chicago Assessors' Plan of Computing Site Values.

[3] Pleydell, A. C. *Rules and Suggestions for Assessment of Real Property*, p. 7.

[4] Milwaukee Tax Department, 1912.

[5] Department of Taxes and Assessments, City of New York. Land Value Maps, 1909, p. 3.

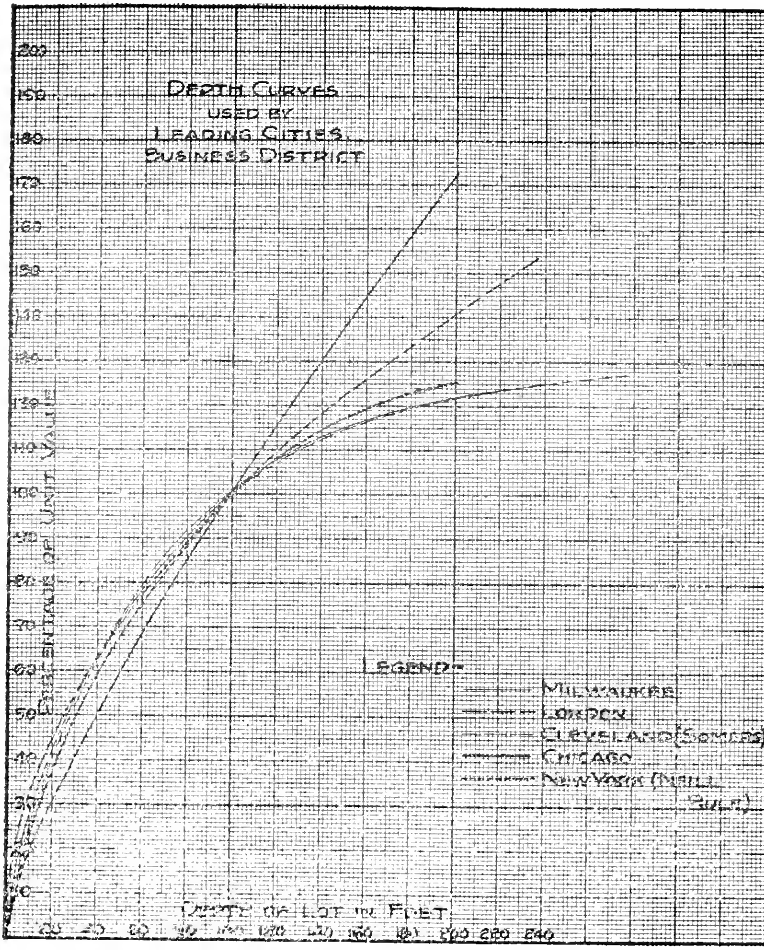

FIGURE 8

The accompanying graphs show somewhat more plainly than the figures the comparative shapes of the various curves used. It will be noted that most of the business curves do not diverge widely from the Neill curve based on the old Hoffman rule but that the Chicago curve much more nearly approaches a straight line, assigning high values to long lots, and the London curve departs in the same direction when a depth of over 110 feet has

been attained. The relatively close agreement of the other curves should not be taken as a conclusive proof of their accuracy since the independence of their origin is unlikely. The Cleveland curve is the one furnished that city by W. A. Somers. It differs materially from the illustrative scale used in his article written in 1905.[1] It is used indiscriminately for residence and business property though Mr. Somers has stated specifically that the curve should vary for different districts.

A distinct residence scale is apparently not used by most of our large cities but Milwaukee is an exception to the rule.

The following table shows the percentages decided upon by different persons as correct for various depths of residence lots in that city.

(1) *Single Tax Review*, Vol. V., p. 27.

TABLE X

PERCENTAGES OF UNIT VALUE ASSIGNED TO DIFFERENT DEPTHS OF LOTS IN THE RESIDENCE DISTRICT. MILWAUKEE

Depth of Lot in Feet.	Milwaukee Curve 1911.[1]	Janssen's Curve.[2]	King's Curve.[3]
5	9	....	....
10	17	12	....
15	24	18	....
20	30	24	....
25	35	30	....
30	40	35	....
40	50	45	45.4
45	55	49	51.7
50	60	52	57.3
55	64	56	62.3
60	67	59	66.8
65	71	64	70.9
70	75	68	74.6
75	78	71	78.0
80	81	75	81.1
85	84	78	83.9
90	87	82	86.5
95	90	85	89.0
100	92	88	91.4
105	95	91	93.7
110	97	94	95.9
115	98	97	98.0
120	100	100	100.0
125	101	102	101.9
130	102	104	103.7
135	103	106	105.5
140	104	108	107.2
145	104	110	108.9
150	105	112	110.5
155	105	113.5	112.1
160	105	115	....
165	106	116.5	....
170	106	118	....
175	107	119.5	....
180	107	121	....
185	108	122.5	....
190	109	124	....
195	110	125.5	....
200	110	127.5	....

[1] Milwaukee Tax Department, 1911.
[2] Worked out from sales records by Fred Janssen of Milwaukee Tax Dept.
[3] Derived by author from records of sales in Milwaukee residence district.

The accompanying graphs show the results of plotting the percentages given in the table. It is apparent that the three residence curves vary but slightly for lots under 120 feet in depth but, for lots of greater length, the divergence becomes

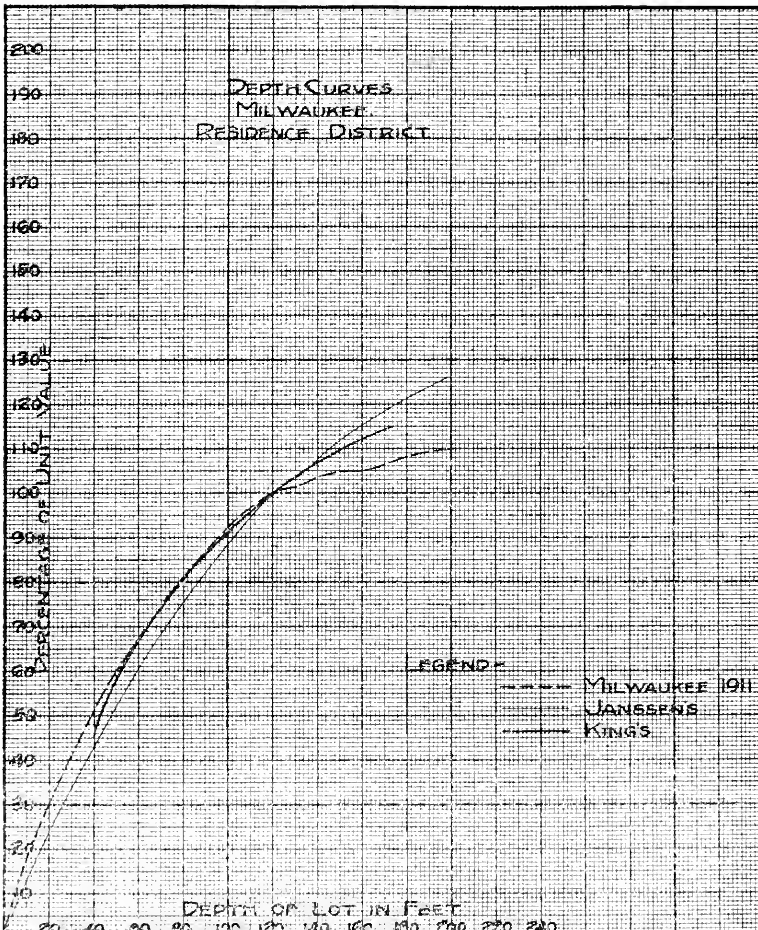

FIGURE 9

marked. The varying results obtained by different investigators in the computation of depth curves apparently indicates that the location of the correct curve for each variety of use is still a matter of doubt or dispute. As a result, a study of the proper

methods of deriving these curves seems very essential. We shall first discuss the derivation of the curve for the retail district.

B. Depth Curve—Retail District

In obtaining a curve of this type, several factors must be taken into consideration. The first of these is frontage value. A moment's thought will convince one that access to the street is of prime importance for two reasons—first, because the street affords a supply of light and air and, second, because it, at the same time, affords an opportunity for advertising. Without light and air, the value of the property would be decidedly decreased and, without show-windows, the retail merchant could not hope to prosper. Light and air are as valuable if obtained from a side street as from the busiest thoroughfare in the city but show-window frontage varies in value almost directly with the number of passers-by.

The show-window, nevertheless, would be practically valueless without some storage space behind it and the storage space varies in importance directly both with its proximity to and the value of the show-window space. In the vicinity of a valuable show-window, every nook and corner in which a supply of goods may be stored is eagerly sought after because of its advantageous location. The more customers attracted into the store, the more valuable is the room which may be utilized for counters and shelves. Storage space near the street is desired primarily because of its access to the light transmitted through the show-windows. This is of less importance in these days of cheap and efficient artificial light than in the times when daylight was the main source of reliance. Proximity to the street adds something to the value of this space but it is a factor of rather secondary importance for, once the customer enters the door, it is very easy to guide him to the desired counter. Some added expense for floor walkers and slightly increased trouble in moving goods from the doorway may make space distant from the entrance slightly less valuable.

The conclusion, then, must be that the first ten feet of depth contains a very large percentage of the entire unit value and that, as one proceeds further back from the street, the

value per square foot decreases slowly. This is true of the upper floors as well and, hence, a curve based on the ground floor alone might not be very materially affected by taking the upper floors also into consideration. This assumption is further borne out by the fact that the frontage on the street affords room for the signs displayed by the occupants of the offices in the second story and above and so passers-by are attracted and business increased.

While a quantitative relationship doubtless exists between value of show window space and that of the adjacent storage room, this relationship is not easily deduced mathematically and it, therefore, seems necessary that we turn to practical experience as our guide. One method of procedure would be to obtain a record of sales of adjacent lots of different depths and thereby compare the prices paid for each. This is the simplest and best method if a large number of records of sales of pairs of lots very close together and differing only in depth can be obtained. Since the majority of the lots sold probably include buildings, it is necessary to deduct the value of the buildings from the total selling price in order to arrive at the value of the land. To do this is no simple task. The most feasible method is to estimate the probable future life of the building and ascertain from the tables the percentage of the present cost of reproduction of such a building present in a building having that expectation of life. The present cost of reproduction is then multiplied by this percentage and the product is assumed to be the present value of the building. This is deducted from the total selling value of the building and lot and the residue should represent the value of the lot.

Evidently, only sales which are close together in point of time can be compared. If the difference in dates is only a year or two and land values have not been changing too rapidly, the error may be reduced by multiplying one selling price by a factor which will reduce it to the same data as the other sale. If, for example, land in general in the neighborhood is supposed to have been appreciating at the rate of three per cent per annum and the given sales are two years apart, the value of the first lot sold should be multiplied by 1.06 to make it correspond with the value of the second at the date when it was sold. If

the lots are not adjacent but some little distance apart and if the assessor's estimates of unit values for the two locations differ but slightly, it may still be possible to use the two lots for comparison by multiplying the value of the lot having the larger unit value by the ratio of the smaller to the larger unit value thus bringing both lots to a common basis.

The lot values cannot be used in the computation of a depth curve unless one of the lots approaches fairly closely to the standard depth. If it is but slightly removed therefrom, it is permissible to make a correction on the base lot, using some standard depth curve as a guide, and dividing the selling price found by the percentage on the chosen depth curve for this depth of lot. Errors due to a faulty depth curve are likely to be so slight for lots within 20 feet of the standard depth, (if this standard depth is 100 feet or thereabouts), that they may safely be neglected. In this way, the value of the base lot is standardized and the ratio of the value of the other lot thereto should give the percentage for the depth of the other lot.

By applying these corrections, this method of computing a depth curve becomes reasonably accurate. Its principal drawback is that only in the largest cities and by the aid of complete sales records is it possible to locate enough suitable instances in the retail district to given even an approach to statistical regularity. It is, however, probably the best method in those exceptional instances in which it can be used since it is the most simple and direct. The chances are that a curve applicable to the retail district of one city will work equally well in the retail district of any other similar city the result being that a determination for New York or Chicago would probably be perfectly correct for smaller cities.

Owing to the impossibility of securing records of a sufficient number of suitable sales in the smaller cities, recourse is sometimes had to another method. This second method assumes the correctness of the unit values as fixed by the assessors. The building value is computed and subtracted as in the first case. The remainder is taken as the selling value of the lot and this value is reduced to a front-foot basis. This front-foot value is then divided by the unit value and the resulting percentage is taken as the percentage of unit value for the given depth.

When a large number of instances have been taken and percentages figured out, it is perfectly possible to derive a curve.

This method *apparently* has the very marked advantage that practically every sale occurring furnishes an item for the derivation of the curve. The decisive disadvantage inherent in this system, however, is that it arrives at results by a system of circular reasoning. Unit values are principally determined by reference to sales records and, in their computation, if the lots are not of standard length, a depth curve must be assumed. Now, the attempt is made to obtain the depth curve by the use of the unit values. Evidently, the second depth curve is merely a more or less perfect reflection of the first one.

The third method of computing depth curves makes use of rentals instead of sales as a source of data. The marked advantage of this mode of procedure is that a large percentage of all lots occupied by buildings may be utilized as items for the study. The investigator operating under this plan computes as accurately as possible, on the basis of information received from owners, tenants, or managers, the net rental obtained for the given building and lot. As in the first method, he next ascertains the cost of construction of a similar building at the present date, estimates the probable future life of the building, and, by referring to the table, ascertains the percentage of cost value normally remaining in a building of the given type with that many years yet to exist. The cost of reproduction new is multiplied by this percentage to obtain the present value of the building. The present value of the building is multiplied by the current rate of interest which gives the net rental of the building itself. This amount is next subtracted from the total net rental leaving the net rental of the land. Since land value varies directly and nearly proportionately with its net rental, the ratio of rentals is almost as good for the computation of a depth curve as the ratio of selling prices. The same corrections for differences in location must be made in the same way as in the case of sales, the assessors' estimates of unit values being assumed to give the correct ratio between the values of the two situations. The same caution applies as to the use of lots situated at any considerable distance from each other or varying materially in characteristics as a basis of comparison. In the case of the lot

used as a base, corrections for slight variations of depth from the standard are made in exactly the same method used in the studies made by means of sales records.

The disadvantage of this method of obtaining a depth curve is that it is difficult to obtain net rentals with accuracy and in the computation of building values very considerable errors are quite sure to occur. Nevertheless, it seems probable that by the use of several hundred or a thousand instances that the errors would tend to compensate and a very creditable curve could be worked out. This method seems to be the only meritorious one for which sufficient data can be obtained in the retail district of a moderate sized city to make it worth while to compile the results and which, at the same time, seems to promise a reasonable degree of accuracy.

C. Wholesale and Manufacturing Districts

The relation of depth to value is evidently decidedly different in the wholesale and manufacturing districts from what it is in the retail district. In the latter, frontage is primarily desired because it makes possible the display necessary to attract the passers-by. In the former, frontage is only necessary to gain access to the street for drayage purposes, to the railroad or river for shipping facilities, or to some open space in order to obtain light and air. A crowd of people in the street is of no benefit to the manufacturer and yields but trivial gain to the wholesaler and it is likely to be of disadvantage to both since it interferes with loading and unloading of coal, machinery, raw materials, sales goods, etc. In the retail shop, storage space is necessary at the point at which customers are to be served. The more customers the more valuable the storage space. As a corollary, the closer to the show-windows, the more valuable the storage space.

In the wholesale house, storage space is more valuable near a street or alley only because it is better lighted and because it requires less trucking to reach the entrance. The same is true in a factory.

For these reasons, it seems evident that depth curves applicable to the retail district may be quite dissimilar to those suited to a wholesale or factory district.

In the wholesale or manufacturing district, the alley becomes of almost as much importance as the street and unit values should be assigned thereto. The depth curve should be applied from the alley frontage in just the same manner as from the street frontage. The two curved surfaces will intersect somewhere toward the rear of the lot. The lot should be valued as two lots, the part between the line of intersection of the curved surfaces and the alley being considered as a lot facing the alley.

The methods of determining the depth curves in the wholesale or manufacturing section are not essentially different from those applicable to the retail district and so no additional discussion is necessary in this place.

D. Inner Residence District

The value of a residence lot is related to its depth but for quite different reasons than those which govern in the case of the retail district. A large amount of traffic is the principally desired feature for retail purposes but it may, on the other hand, render property along a residence street much less valuable. In practically every residence district, there is a line some feet back from the street which is determined upon by custom, public opinion, convenience or written contract as determining the front of the building. The space between this line and the street, be it five or fifty feet, is reserved for walks, lawn, etc., and is rarely encroached upon by the builder. The space intervening between this line and the street is of very little value by itself except for the fact that it controls the use of the part of the lot further to the rear. It may, of course, be utilized to enlarge the lawn of the adjacent lot. For practical purposes, however, the depth curve may be said to commence at a distance back of this line sufficiently great to allow of the interposition of some kind of a building. The value increases, then, quite rapidly as the lot grows longer until the depth is sufficient to accommodate a building of the size adapted to that location. The space still further to the rear is useful primarily as lawn or garden and is normally much less valuable than the building space. In a section in which the typical residence front is thirty feet from the street and the ordinary depth of

the residences is thirty five feet, one would anticipate a depth curve something like the following:

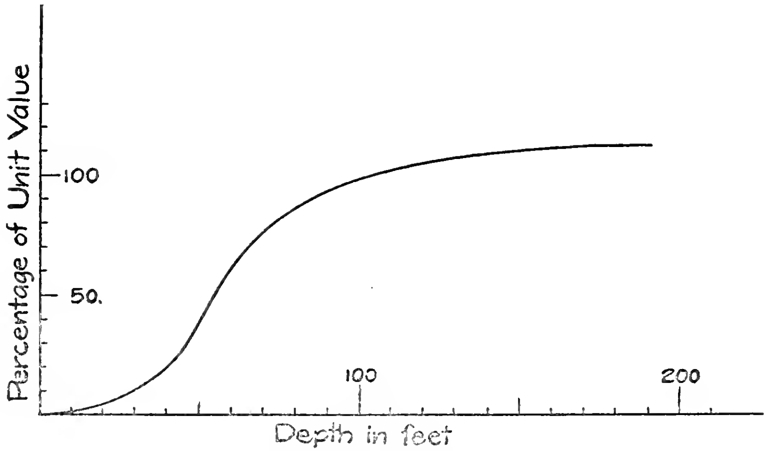

FIGURE 10.—TYPICAL DEPTH CURVE—RESIDENCE DISTRICT

It will be noted that there is an extremely rapid increase of value as the lot grows long enough to admit a full sized house but, once this depth is attained, the increase in value becomes decidedly slow.

As in the case of the retail district, all three methods may be used in the calculation of a depth curve. The first method is likely to succeed better here than in the down town section for the residence district covers a larger area, sales are more numerous, and values change less abruptly, hence pairs of lots at a greater distance apart may be legitimately compared.

The third method may also be used here with success but the investigator is hampered in certain sections by the fact that a large percentage of the homes are occupied by the owners and estimates as to rental values are, in such cases, likely to be extremely hazy, especially in the case of fine modern residences. Enough suitable instances may, however, be obtained to permit of a fairly satisfactory study.

The following tables and graphs show the results of a study made in the City of Milwaukee by the author according to the first method. The sales records used were those of 1909–1911.

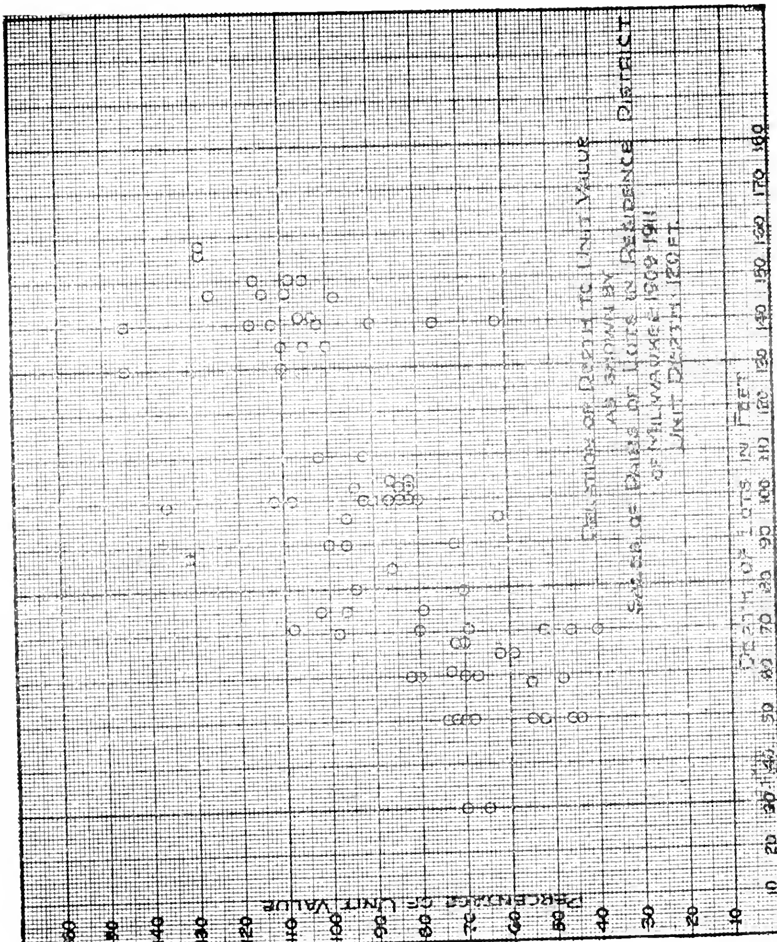
RESIDENCE DISTRICT
OF MILWAUKEE 1909-1911
UNIT DEPTH 120 FT.
PERCENTAGE OF UNIT VALUE
10
20
30
40
50
60
70
80
90
100
110
120
130
140
150
160

Figure 11 shows the individual instances. While there is considerable dispersion, the general trend is clearly discernible.

Table XI shows the results averaged for the various depths. A regular trend becomes now more clearly apparent. These percentages are plotted in Figure 12 and the irregular line thus obtained is then smoothed. The percentages for the different depths, (based on a 120-foot unit), as shown by the smoothed curve, have already been given in Table X. It will be seen by figure 9 that, until lots over 120 feet in length are considered, this curve does not differ materially from the residence curve used in Milwaukee in 1911. To longer lots, it gives a considerably higher value than does the 1911 Milwaukee curve.

TABLE XI

AVERAGE PERCENTAGES OF UNIT VALUE FOR RESIDENCE LOTS OF GIVEN DEPTHS AS SHOWN BY THE SALES RECORDS OF MILWAUKEE, 1909-1911.

Computed from Chart 11.

Depth of lot, in ft.	Average percentage of unit value.	Number of instances from which average was computed.
50	59.8	8
60	66.9	8
70	74.0	13
80	78.8	2
90	88.1	8
100	97.2	9
105	88.0	7
110	91.7	3
120	100.0	Assumed
133	116.1	5
140	102.6	9
150	116.2	9

The following curve is not based upon a study of a large enough number of items to entitle it to lay any claim to great accuracy but it illustrates the method of deriving such a curve

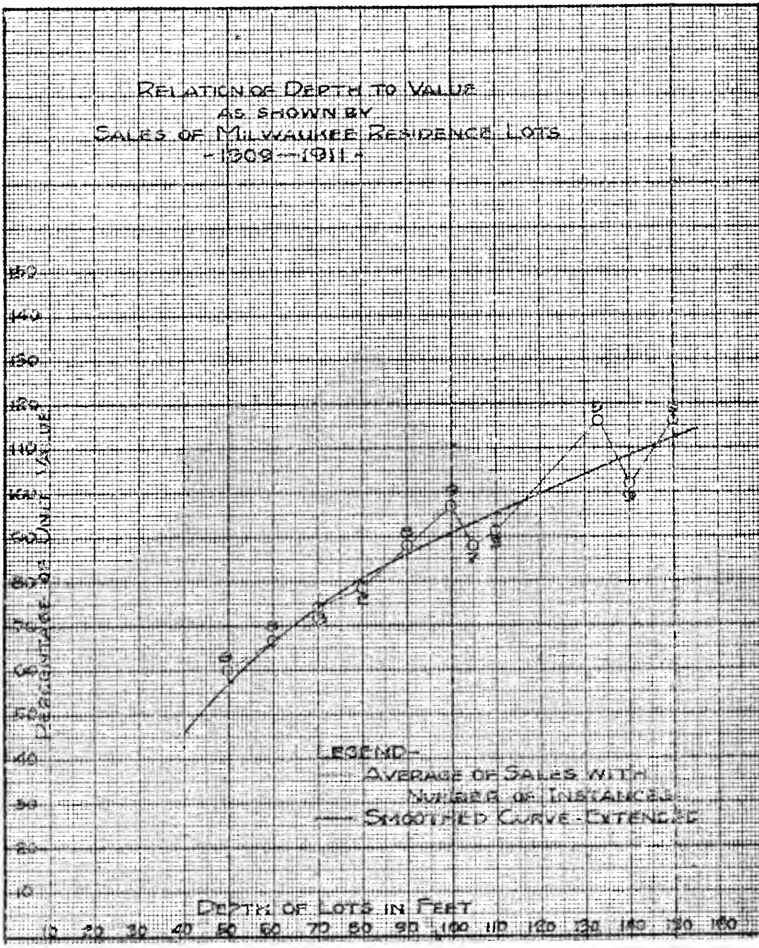

FIGURE 12

from the sales records and may be of some use as a preliminary study.

The sales records were collected by Mr. Fred Janssen of the Milwaukee Tax Department and verified by Mr. Paul Reynolds

of the Wisconsin State Tax Commission. The value of the buildings was computed from data and measurements secured by various city assessors. Corrections were made for differences in unit value, dates of sale, and variations from the normal standard of 120 feet in the depth of the lot used as a base. Building values were computed by the aid of tables of cost per cubic foot for various types of buildings, the figures being furnished by Milwaukee architects. Depreciation was figured by the Somers' curve as given in the Report of the Cleveland Board of Assessment.

E. Suburban Residence District

The conditions determining the relationship of depth to value do not here differ materially from those in the inner residence district. The front lawns are normally somewhat deeper and the houses smaller thus altering the shape of the curve to a considerable extent.

The first method of determining the curve is usually especially applicable here owing to the large number of sales ordinarily occurring and also owing to the fact that a very considerable percentage of these are of vacant lots. This simplifies the problem decidedly since it is unnecessary to go through the troublesome and always more or less inaccurate process of deducting the value of the building. When such value must be deducted, a larger percentage of the buildings are comparatively new and hence approach more nearly to their original cost of construction. This last mentioned fact is also of advantage when the third method is followed since it enables proper deductions for building rent to be made with a greater degree of accuracy.

CHAPTER V

ALLEY INFLUENCE

A. Retail District

While an alley is less essential in the case of a retail store than in that of a wholesale establishment, it is nevertheless true that, in most instances, a lot adjoining an alley is decidedly more valuable than one whose rear is enclosed. The alley permits the lot owner to cover his entire lot with a building and still obtain light and ventilation from the rear. It also greatly facilitates business by permitting the bringing in of goods without thereby impeding the entrance of customers or littering up the front of the store. Evidently, an alley approach is more valuable in case custom is large and storage space is highly utilized than in those cases in which there is little business. It is also more essential when the store room is deep and hence light becomes a matter of increasing importance. Besides, with much storage room, more goods will probably be brought in. For these reasons, it would seem that the value of the alley might best be approximated by assuming it to be a percentage of the front foot value for the lot. Various other methods of measuring alley influence are in vogue or have been proposed. A common way is to simply consider the whole or part of the alley as added to the area of the lot. Messrs. Lindsay and Bernard of the Baltimore Tax Department hold that the entire breadth of a rear alley should be added to the length of the lot before applying the depth curve. Under the Somers' System, only a part of the alley area is added to that of the lot. The objection to simply adding part or all of the alley area to the area of the lot is that this method would ascribe a much greater value to a twelve-foot alley located thirty feet from the street than it would to an alley of the same width located at ninety feet from

the street. As a matter of fact, a lot only thirty feet deep would be but slightly benefitted by an alley at the rear, while, with a lot ninety feet in depth, the alley becomes a matter of prime importance and, therefore, it is decidedly more valuable.

A still more simple method of calculating alley value is to add a fixed percentage to the depth factor whenever an alley of a given width is present. This also is faulty in that it fails to take into account the increasing value of the alley as the lot becomes deeper.

For these reasons, it appears to be more accurate to consider that alley frontage adds a percentage to the front foot value, this percentage varying with the character of the alley. These percentages, once determined, might be outlined for the use of the assessors in a hypothetical table something like the following.

TABLE XII

PERCENTAGE OF FRONT FOOT VALUE TO BE ADDED FOR EACH FOOT OF VARIOUS KIND OF ALLEY FRONTAGE

Width of alley in ft.	Rear Alley		Side Alley	
	Paved	Unpaved	Paved	Unpaved
2	1.2	.8	.6	.4
3	1.5	1.0	.7	.5
4	1.8	1.2	.9	.6
5	2.1	1.4	1.0	.7
6	2.7	1.6	1.2	.8
7	3.0	2.0	1.5	1.0
8	4.4	2.9	2.2	1.4
9	4.7	3.1	2.3	1.5
10	5.0	3.3	2.5	1.6
11	5.3	3.5	2.7	1.8
12	5.6	3.7	2.8	1.9
13	5.9	2.9	3.9	2.0
14	6.2	4.1	3.1	2.1
15	6.5	4.3	3.2	2.2
16	6.8	4.5	3.4	2.3

As this table indicates, the value of the alley would increase with its width. A very narrow alley will afford some light and air but a broader alley will serve this purpose much better. When the alley is broad enough so that a wagon can pass through, its value is at once greatly enhanced, taking a sudden jump at this point. A still wider alley affords room in which to work while loading and unloading, etc., and an alley sixteen feet wide is desirable in that it permits two wagons to pass. An

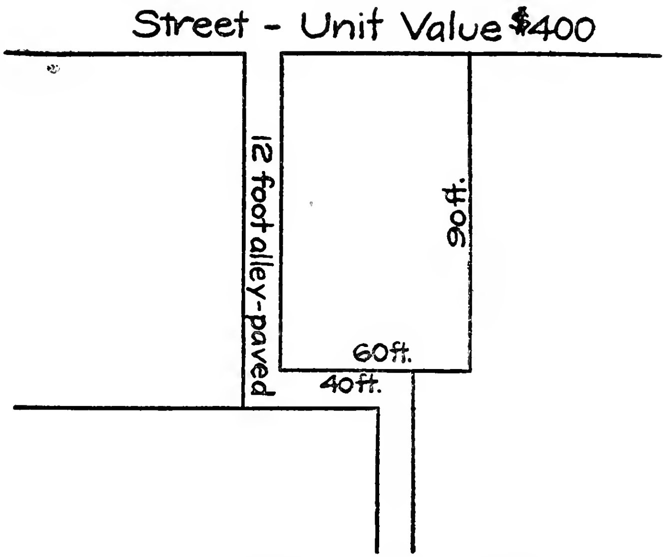

FIGURE 13.—VALUATION OF ALLEY FRONTAGE

alley more than sixteen feet in breadth is unnecessary unless it is to be converted into a street and, when this is done, the frontage should be figured on a street basis.

It is quite evident that a paved alley is more desirable than an unpaved one. The total value of a side alley is likely to be larger than that of a rear alley but, since most lots are greater in depth than in frontage, the value per foot of alley is likely to be less.

Let us see how this table would be used in practice. Suppose that we have a lot like A in Figure 13.

This lot has 90 feet frontage on the side alley and 40 feet at the rear. The unit value of the street is $400 and the percentage

for the depth is 95 making the front foot value \$380. From the above table, we must add thereto 90 x 2.8 x \$380 or \$957.60 as the benefit of the side alley and 40 x 5.6 x \$380 or \$851.20 as the added value due to the rear alley making a total allowance for alley influence of \$957.60+\$851.20 or \$1,808.80. This amount, then, should be added to the computed value of the lot.

The same process expressed algebraically would read:

Let u = unit value of street.

d = depth of lot.

p = percentage on depth curve.

f = front foot value.

s = frontage on side alley.

x = factor for side alley frontage.

r = frontage on rear alley.

y = factor for rear alley frontage.

A = value of alley influence.

Then $f = up$

and $A = f\,(sx+ry) = up\,(sx+ry)$

If only the rear alley frontage existed, then sx would be omitted and we would have $A = fry$.

By use of this formula, it is extremely easy to calculate the value of the alley influence when x and y are given but it is not a simple matter to obtain the correct values for x and y under various conditions. For the derivation of a table like the one shown above, instances must, of course, be chosen in which only one kind of alley frontage is present. If the lot has a rear alley only, then $y = \frac{A}{fr}$; f and r being known, the problem is to find A.

To do this, one method is to compare the selling price of lots exactly alike except that one has alley frontage and the other has not. The difficulty with the plan is that such instances are rare and it is extremely unlikely that both lots have been sold at approximately the same date, hence it is almost certain to be impossible to collect sufficient data in this manner.

As a result, rentals seem to supply the only available source of information. Instances must be sought of lots adjacent or in close proximity to each other and similar except as to alley frontage. The difference in net land rentals must be ascer-

tained in the same way as described in the last chapter. This difference in net rentals, capitalized at the current rate of interest, should give A and the derivation of y follows at once. x would be determined in a manner exactly similar.

B. Wholesale and Manufacturing Districts

An alley in the wholesale or manufacturing districts answers most of the purposes of a street for it furnishes light and air and transportation facilities. It should therefore be assigned unit values just like a street and depth curves applied thereto. The unit values are likely to be considerably lower than for a street because the alley furnishes too narrow a space for adequate drayage facilities and it is unsuited for office locations. Besides, many manufacturing and wholesale houses like to make some display in the way of imposing buildings, advertising signs, etc.

Either an alley occupied by a railroad track or a frontage on a navigable river may give a higher unit value than frontage on a street.

When a lot has two frontages, it must be valued as two lots, the line of demarcation being the intersection of the two depth-curve surfaces. A table showing the line of intersection for different depths and ratios of unit values may very easily be prepared for use by the assessors.

C. Modern Residence District

In that part of the residence district in which practically all of the houses are equipped with heating and plumbing facilities and in which the keeping of horses is the exception rather than the rule, alley frontage adds nothing to the value of a lot. The occasional advantage of having a rear entrance for automobiles or carriages is offset by the damage done to surrounding property by the presence of ash piles, refuse heaps, and garbage cans. Hence, in this district, no value should be added for alley influence.

D. Closely-Built Residence District

In those sections in which flats and tenements predominate, an alley is frequently highly advantageous. Long rows of solid front buildings offer no rear entrance facilities except through the alley. In these sections, also, the unsightliness of ash heaps and garbage cans is not considered as great a drawback as in the stylish residence quarters and, in many cities, these eye-sores are kept at a minimum by the health department.

Unlike the case in the retail district, the rear alleys do not become more important as lots become deeper but remain of approximately constant value since the residence rarely covers the lot to its full depth. As a result, it seems better, in this case to add to the percentage found on the depth curve for a lot of the given depth a percentage of the unit value, fixed for each type of alley. Thus, if for a lot 140 feet in depth, the curve shows 113.0 per cent of the unit value and the alley factor from the table is 6.8 for a sixteen foot paved rear alley, the two percentages should be added making the depth factor 119.8 per cent.

In this sort of a district, side alleys become of very considerable value. Flats seldom extend to the full depth of the lot but they very commonly extend over its entire frontage. The presence of an alley obviates the necessity of courts or other devices for admitting light and air to the flat adjacent to it. It is somewhat akin to owning an extra lot alongside of the building but is not so valuable as such a lot because the owner of the building cannot plant this alley space to flowers and grass and exclude the public from its use as he could were it his private property. Since, however, it partakes largely of the character of such a lot, it is legitimate to follow the Somers' plan and add a definite fraction of the alley area to that of the lot adjacent in computing the value of the latter. The proper fraction to be added must be determined by an inductive study similar to the one already described for the retail district.

E. Outer Residence District

In the less modern and outlying suburban districts, an alley is considered an essential adjunct of a residence lot. Neces-

sary barns, coal-sheds and other outbuildings are usually located along the alley and a lot without an alley at the rear is at a serious disadvantage.

What manner of valuing these alleys is best adapted to the conditions? Instances in which a rear alley is close to the street in front are so few as to be negligible. For lots of ordinary depth, the alley would apparently be about as valuable whether it was located at eighty or one hundred and eighty feet from the street. In either case, it is almost indispensable. It seems best, therefore, to consider the rear alley factor here as a percentage of the unit value rather than as a percentage of the front-foot value, corresponding therefore with the practice for closely-built residence lots and not with the method applicable to the business district.

If a rear alley is present, a side alley adds nothing to the value of a lot in this location. Since the residences are not close together, any gain in light and air is offset by the danger of the alley being utilized as a location for unsightly buildings, refuse heaps, etc. In fact, such alleys are frequently nuisances and deductions must be made from the computed value of lots on the opposite side. When there is no rear alley, the side alley is often quite necessary though it is considered much less desirable than the rear alley. Its value, like that of the rear alley and for the same reasons, is proportional rather to the unit value of the street than to the front foot value of the lot. The extent of the side alley frontage has little bearing on its value hence should not be taken into consideration.

If $A =$ value of side alley,
$u =$ unit value of street,
$x =$ side alley factor,
$F =$ frontage of lot.

The formula becomes

$$A = Fxu$$

$$\text{or } x = \frac{A}{Fu}$$

In this case the value of x may be determined by a study of sales of vacant lots but it will be a difficult process to collect sufficient data. Rentals may furnish a better basis but no method is apt to give more than a rough approximation to the

correct percentage. Since land values in these sections of the city are comparatively low, the revenues will not be materially affected by inaccuracy in determining the alley factor.

CHAPTER VI

CORNER INFLUENCE

A. Retail District

It is a well recognized fact that corner lots are more valuable than interior lots. This is evidently true because of the fact that they have a greater street border, thus containing more show-window space and having better access to light and air and more possible customers pass by.

In the case of vacant building space, the land should be valued strictly according to location without regard to the present shape of the lots or their ownership for, at any time, the lots are likely to be consolidated or subdivided and recombined in new shapes so that they may be used in the most advantageous form. But, when once a costly building has been erected, the probability of change is greatly lessened. In this case, the shape of the lot must be regarded as temporarily fixed and the lot must be assessed accordingly. If the owner has failed to utilize his lot most profitably, he is already penalized and to place additional tax burdens upon him seems not in accordance with justice.

We shall first take cognizance of those cases in which buildings have already been erected. The first case under this head will be the valuation of lots facing a street at some point between the corner and the point of minimum valuation in that block.

If we assume frontage value to be twenty-five per cent of the entire unit value in lot B, illustrated in Fig. 14, it might, at first, be thought that the frontage value would be equal to one-fourth the frontage times unit value—in other words to ¼ (60 x 50) or $750. A little reflection, however, will convince us that such is not the case.

As has been before noted, the frontage value is largely determined by the number of passers-by. This holds especially for the ground floor but, in the case of office buildings, it is also of some importance for the tenants of the upper floors. Since the unit value on the side street is worth $60 per foot at the minimum point in the block, there must be many patrons normally passing along this street. There are, however, evidently fewer

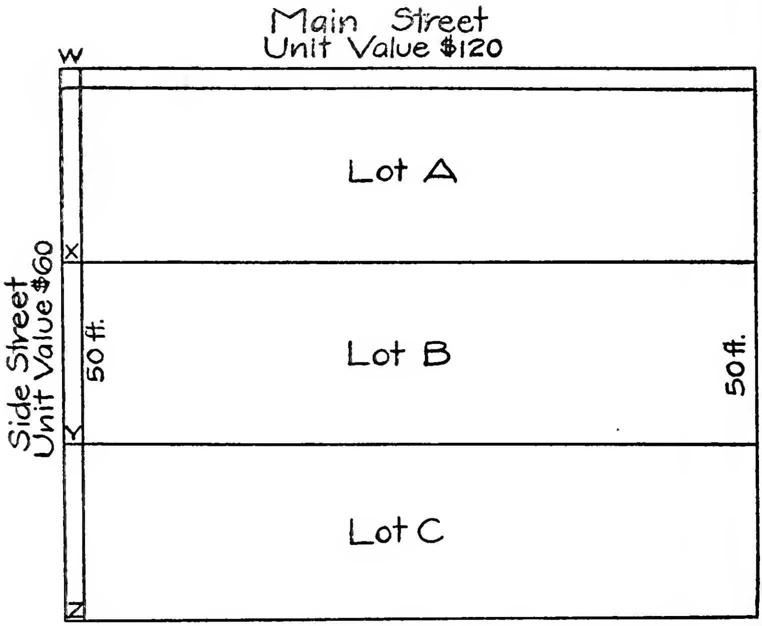

FIGURE 14.—DEFLECTION OF TRAFFIC ALONG CROSS-STREET

of these regular passers-by here than on the main street as is evidenced by the fact that land is so much more valuable along the latter. Some of those passing along the main street will, undoubtedly, turn off the beaten path to patronize some shop on the side street. For this reason, frontage between W and X will be slightly more valuable than that between X and Y and that between Y and Z will be in a poorer location still. The gain above the unit value accruing between W and X, for instance, is not, then, in any sense, a function of the unit values of the side street but of those of the main street. No one can

doubt that the more dense the traffic on the latter the more it will affect values on the former. It is also evident that, the further the location from a corner, the less is the influence of the cross-street traffic. The conclusion, therefore, follows that a curve must be derived which will show the effect of a cross street on frontage values. Since unit values are probably proportional to frontage values, they will be likewise affected. This curve, then, will show a percentage of the unit value on the main street which must be added to the unit value on the side street for frontage influence. Such a table might read somewhat as follows:

TABLE XIII

SCALE OF CROSS-STREET INFLUENCE

Feet from corner.	Per cent of cross street value to be added.
10— 20	9
20— 30	8
30— 40	7
40— 50	6½
50— 60	6
60— 70	5½
70— 80	5
80— 90	4½
90—100	4

If the frontage on the side street extends from 30 to 80 feet from the corner, sufficient accuracy would be obtained by using the average of the five percentages. Thus (7 plus 6½ plus 6 plus 5½ plus 5) ÷ 5 = 6 per cent. The minimum frontage value on the side street is $60. That on the main street is $120. The resulting frontage value for lot B would, therefore, be $\left(\frac{\times 120}{100} + .60 \right)$ 50 or $3,360. The depth curve may now be applied to this valuation in the same manner as usual.

In the case of the corner lot, additional frontage value is conferred upon the show-window space, and hence upon the lot to the rear thereof, by reason of cross-street traffic but the added value of the show-window space is not measured by the amount of traffic turned aside from its direct route. Those persons deflected from the main street down the side street

rarely indeed are net additions to the list of customers of the corner shop, for, as a rule, they would proceed, to the front entrance as readily as to any side entrance. In nearly all cases, they either pass down the street to go to some other shop or else would have come into the corner shop anyway so that, in either case, the corner store gains nothing. The measurement of corner influence on the corner lot is accomplished therefore in a different manner which will be discussed later and the effect of diverted traffic is not considered as giving additional value to the lot.

If the corner building has a side entrance for the offices above, it would seem that a decided exception must be made. In this case, however, the building probably loses more traffic by not having an entrance on the main street than it gains by added side street traffic, hence it cannot legitimately be taxed extra on that account.

It is of course, true that no mechanical system will work out with perfect equity but these considerations would seem to warrant a different treatment for the lot covered by the corner building than for other lots. This gives rise to the query as to what shall be done in case the corner building is occupied on the ground floor by several different stores or shops. Unless these are separated by permanent walls into different buildings, the best plan is to treat the whole as a single corner lot. Partitions may readily be shifted and it is the business of the owner of the building to so divide it as to gain the maximum advantage from his ground space. If each part is assessed separately, great practical difficulties are certain to arise. Therefore, the most feasible plan is to consider the ground covered by the corner building as a united whole. The method of evaluating this area will be taken up a little later. Meanwhile, let us consider the mode of deriving the percentage table for showing corner influence on frontage values of inside lots, a table the existence of which we so conveniently assumed in this discussion.

For the purpose of this determination, there should be chosen a side street well lined with shops which face it and with the corner shop extended but a short distance along the side

street. Otherwise, the data would not be complete enough to prove of much service.

Two methods of attack are available. The first is the traffic-count method. This consists of a traffic-count at the minimum points in the blocks on the main street on each side of the cross street. These two counts should be averaged to give the main street traffic. Next, the traffic down the side street should be counted at different distances from the main street and the rate of decrease computed until the minimum point in the block is reached. The differences between this minimum and each of the other points in the block should be used as numerators and the traffic on the main street as a denominator in each case. The percentage deflection at different distances may thus be computed. By making a number of such tests and averaging results, an approximation to the normal percentage of street traffic deflected to different distances along cross-streets might be obtained.

Another method, which is more direct, is to determine the rental values of buildings or shops of corresponding size and character at different places along the side street and, in this manner, obtain a similar curve. This is best if sufficient data can be obtained but, in most instances, this seems doubtful.

If we wish to value corner lots or vacant territory comprising the corner and adjacent lots, we must proceed in quite a different fashion. The method used must take account of the two fronts available and also the added value of the storage space due to its proximity to the show-windows. Mr. W. A. Somers has apparently taken both these factors into consideration but his exact method of procedure is not available to the public.

In his system of valuation, he assumes that the corner influence extends 100 feet from the corner. While this figure is arbitrary and the actual influence will probably vary in extent under different conditions, it will probably facilitate computations to consider the influence beyond 100 feet as negligible. Mr. Somers' original plan of valuing corner lots was based on a diagram like the following:[1]

(1) *Single Tax Review*, Vol. V, p. 31.

By the diagram below, if the two streets each have unit values of $1,000 per front foot, the lot will be worth about $95,000 but if the two streets have a value of only $500 each, the lot will be valued at only some $33,000. There seems to be no logical reason as to why this value should not be exactly half of the former—in other words why the series of crosses on the dia-

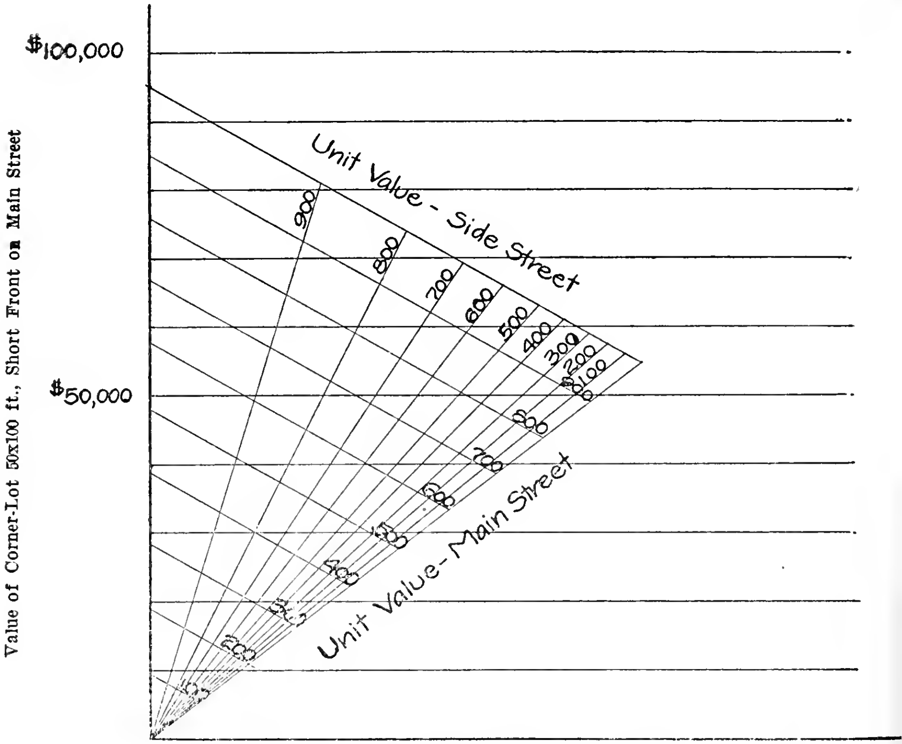

FIGURE 15.—SOMERS' CORNER-LOT DIAGRAM

gram should not follow a straight line instead of a curve. This defect would seem to render the diagram almost worthless. Besides, it is applicable only to a lot of specific size which would prevent its general application to other areas unless a special diagram were constructed for each.

In the valuation of property in Cleveland, Ohio, under Mr. Somers' direction, a table is constructed based on a valuation of a $100 per front foot on the main street and a varied scale of

values on the side street. This table is given below.[2] The main criticism of such a table is that it fails to specify the particular depth of lot to which it applies. The percentage for a lot 120 feet deep would be radically different from that applicable to a lot 30 feet in depth especially for relatively high side-street values. If such tables are used, evidently a table must be prepared for each different depth of lot.

TABLE XIV

SOMERS' TABLE OF CORNER INFLUENCE

Side Street Unit Values.	Percentage of Gain for Various Widths of Lots. Front Street Unit Value $100. Width of Lots in Feet.								
	20	30	40	50	60	70	80	90	100
$10	28	23	19	17	15	13	11	10	9
20	36	29	25	21	19	16	15	13	12
30	44	36	30	26	23	20	18	16	15
40	53	43	37	31	28	25	22	20	18
50	63	52	44	38	33	30	26	24	21
60	75	62	53	45	40	35	32	28	26
70	89	74	63	54	48	42	38	34	31
80	108	89	76	65	57	51	46	41	37
90	128	105	90	77	67	60	54	49	44
100	148	122	104	90	79	70	63	56	51

As to whether this table is based upon scientific study and methods or upon empirical rules does not appear either from the table itself or from any evidence at hand. It differs quite decidedly from the table[3] used in the valuation, under Mr. Somers' direction, of similar property in St. Paul. In Cleveland, lots of irregular size were valued by means of a chart[4]

(2) *First Quadrennial Report of the Board of Assessors of Real Property of Cleveland, Ohio*, p. 16.

(3) *First National Conference on State and Local Taxation*, p. 132.

(4) *First Quadrennial Report of Board of Assessors of Real Property*, p. 15.

showing the values of each ten foot square area in the larger corner square of 10,000 feet. Evidently, a large number of these charts would be required to correspond to different ratios between unit values on the main and side streets. As a matter of fact, however, this seems to be the only practical method of arrangement by which scientific methods may be made available for the use of the assessors.

Since the scientific accuracy of the Somers' tables is not proven and since these tables and their derivation are shrouded in secrecy, it seems necessary to derive a method of corner valuation and ultimately a series of charts, which may lay some claim to a scentific basis and, at the same time, accord with actual conditions. The first step required is the separation of the value of frontage from the value of the storage space or standing room.

The large percentage assigned by practically all existing depth curves to the first few feet of depth is due to the frontage value. On the Somers' curve, about 14.3 per cent of the unit value is assigned to the first five feet of depth and 25 per cent to the first ten feet. Show windows normally extend back to a depth of from five to ten feet from the front. The question, then, as to just how many feet should be allowed for show-window space and just what percentage of the unit value should be ascribed thereto is one that apparently can only be solved inductively.

The problem of the exact amount of depth to be assigned to the frontage strip is, in reality, not one of first importance for the very fact that show-windows are sometimes made deeper and sometimes shallower indicates that the value of frontage shades off imperceptibly into the value of the storage space to the rear. In the following pages, the frontage strip has been arbitrarily considered as having a depth of 5 feet and as comprising 14.3 per cent of the value, the amount assigned to that depth by the Cleveland curve. This may or may not closely approach to the facts of the case. The following figure will help to make clear the mode of separation of frontage strip and storage space.

In the figure, the frontage strip on Main Street would be worth, by the assumption, $.143 \times \$800 \times 200 = \$22,880$, while

that on Side Street would have a value of .143 × \$300 × 240 = \$10,296, the little corner square being counted twice since it faces both streets. As a matter of fact, however, this mode of calculation is inaccurate because the side street frontage is more valuable near A than near B owing to the fact that persons passing down Main Street are likely to be attracted

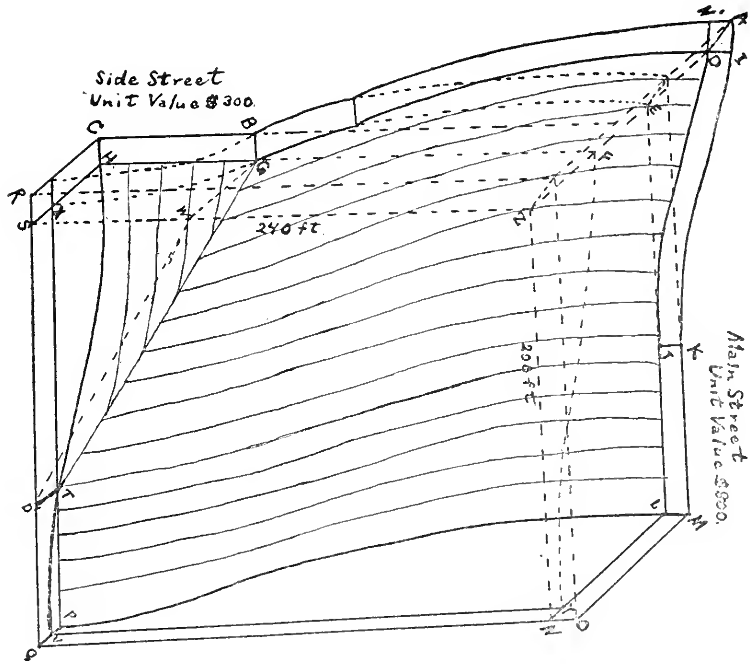

FIGURE 16.—RELATION OF FRONTAGE STRIP AND STORAGE-SPACE TO CORNER-LOT VALUES

by displays in the show-windows at C or even at D. Similarly, those walking along the side street will see the displays at E and F and will, therefore, be tempted to enter and make purchases. The result is, then, that frontage value falls off in both directions as the distance from the corner increases. Since the value of the storage space is directly proportional to the value of the frontage strip, the storage space value

likewise diminishes as the distance from the corner increases. As a result, we have a curved value-surface sloping away from each of the streets intersecting at the corner. The valuation of a corner lot is best understood by reference to the accompanying diagram in Figure 16.

This represents a corner lot with the principal street along A M and the secondary street passing along A C. The value of the show window space is represented by the L-shaped figure C R S H A E Z M O N L. The part of this due to corner influence is equal to B G F A D + E D A J K. The value of storage space may be divided into primary and secondary value. The primary value is that which is derived from the street of greatest influence. The primary value derived from street A C terminates along the plane G T D′ W while the primary value from street A M extends to the plane G T D′ W, and also to the plane T D′ Q P. The primary value of the storage space is figured just as if this part of the lot were divided into two parts by the plane G T D′ W, each part being valued according to the influence from the street controlling it. Thus, in the illustration, the primary value derived from the principal street consists of the figure D Z L N P Q D′ T W G while the primary value derived from the secondary street equals the figure G W H S T D′.

But storage space in the vicinity of two valuable frontages may serve either front and, hence, is more valuable than storage space facing either street alone. Owing to this fact, it derives a secondary value due to the influence of one street as well as a primary influence due to the other. This secondary influence is probably about a constant fraction of the primary influence which it would receive from the same street were this not overshadowed by the primary influence of the other.

The primary influence of the street A M extends from D L to G W T but it also exerts a secondary influence on the remainder of the storage space, this secondary influence being measured by a fraction of the figure G X S D′ T W. The street A C, while having but a small volume of primary influence, exerts a large amount of secondary influence. The latter is

measured by the volume F G W T V Y N Z D′ Q times the given factor.

In valuing the corner, then, several unknown quantities must be determined even when the unit values and the depth curves are known. First: the line G T must be located for various ratios between the two unit values of the intersecting streets. Second: the curves A K and A B must be ascertained for the various given unit values. Third: the constant must be worked out which, when used as a coefficient by which to multiply the volume of secondary influence, will give the correct value of that influence. The first question is easily answered by a mathematical determination of the line of intersection of the two curved surfaces. The curvature of the surfaces is so slight that this line of intersection is likely to be nearly straight.

To determine the curvature of A B or A K is not so easy. The altitude of A F, and hence the area of D F G, is determined by the volume of the street traffic passing along A M. Likewise, the altitude D E is dependent on the density of the traffic along street A C. The corner square A I D N′ is evidently in full view of those passing along each of the intersecting streets. Its value must, therefore, be the sum of the frontage strip values for the two streets. In other words, D Z must equal C R + M Q. For practical purposes, it is probably sufficient to assume that the added frontage value does not extend more than 100 feet from the corner. It will tend to vary inversely with the distance from the street crossing from which the frontage is viewed. If the street is 80 feet wide, this would give approximately the following percentages of the cross-street frontage value to be distributed at varying distances from the corner.

TABLE XV

CROSS-STREET INFLUENCE ON CORNER LOT FRONTAGE

Feet distant from corner.	Percentage of added value.
0	100
10	96
20	94
30	68
40	53
50	40
60	29
70	20
80	12
90	6
100	0

The determination of the ratio of secondary to primary influence is a difficult matter. It seems quite probable that this ratio is a constant but this is merely a theoretical assumption which remains to be proven.

For its determination, the first essential is the construction of a series of charts based on previously determined depth curves and showing the values of the primary influence and the secondary influence considered at 100 per cent. These charts should be ruled off to give the value of each 5 foot square in a corner area of at least 120 feet square. Primary values and secondary values should be entered in the chart in different colors. These should next be cumulated both vertically and horizontally—beginning at the corner. The result is that, by laying off on the chart the dimensions of any rectangular lot, the approximate value will appear in the lower right hand corner. If the dimensions are not in even multiples of five, the correct value may be quickly approximated by interpolation.

It is necessary to construct a series of these charts corresponding to different ratios between the unit values of the

front and side streets. The more charts in the series the less inaccuracy will arise from interpolations. For practical purposes, ten charts is apparently the minimum.

When once the charts have been prepared, several methods of procedure are possible. The best one is to use sales records where such are available, *the modus operandi* being as follows:

1. Ascertain the selling price as accurately as possible.
2. If the lot when sold was occupied by a building, calculate the building value by methods previously elucidated and deduct it from the selling price, thus arriving at the price of the land.
3. By use of the proper table, interpolating if necessary, find the primary value for the lot of this size and deduct from the selling price of the lot thus arriving at the secondary value.
4. Divide the secondary value thus obtained by the secondary value given in the table for a lot of this size and the result will be the desired ratio.
5. Calculate as many of these ratios as possible and assume the median of the results to be the correct value for the coefficient which may be designated by the letter k.

This process may be varied by using rentals instead of sales as a basis. In this case, the order of procedure is thus:

1. Locate a corner occupied by a comparatively new building, obtain the net rental of land and building and capitalize at the current rate of interest.
2. Deduct from the value thus found the value of the building as computed from the cost, less the normal depreciation to date, thus arriving at the value of the land.
3. Proceed as in steps 3, 4, and 5 in the first method given.

Both of the above methods have the defeet that, in obtaining the final constant, both numerator and denominator depend upon the correctness of the estimated unit values of the two streets. A third method which aims to eliminate this error from the numerator is given below. The numerator being the smaller quantity the error therein is most important but, on the other hand, the errors in both numerator and de-

nominator being in the same direction may compensate each other and reduce the error in the ratio. The third method is likewise based on rentals and the steps are as follows:

1. Find a corner lot and an inside lot near to each other and both occupied by buildings similar in height, depth, and construction. Ascertain the rental of each. Correct the rental of the inside lot to bring it to the same frontage as that of the corner lot.
2. Subtract, and obtain the excess rental of the corner lot. Capitalize at the current rate of interest which gives the excess value due to corner influence.
3. Subtract the value of an inside lot of equal area from the primary value of the corner lot. Subtract the remainder thus obtained from the excess value obtained in operation No. 2. The remainder is the part of the excess value due to secondary influence.
4. Proceed as in operations 4 and 5 under the first method.

One weakness of this method of computation is that it presupposes that the rent of each of the buildings proper is identical. This is usually fallacious because the cost of constructing a corner building is likely to be considerably greater than the cost of the inside building and hence a larger share of the rent must be assigned to cover the extra building cost. The extra cost is rendered necessary by the large amount of outside wall composed of better material and usually decorated to some extent.

Another drawback of this method is the fact that, in the majority of instances actually occurring in which the corner building and an inside building are alike, the structures are not up-to-date and hence the rentals are often not representative.

A study by this method of 58 pairs of buildings in Milwaukee resulted in a median value for k of .642 which may, perhaps, not be far from the true value, but the dispersion in the results and the comparatively small number of items studied renders any assumption as to the correctness of this average entirely unwarrantable.

Once having obtained the correct value of k, the next step

is to multiply all the secondary influence values in the chart by k and add the products to the primary influence values. This will give the value of each 5-foot square in the lot. These values being cumulated vertically and the resulting sums being again cumulated horizontally, a set of tables is prepared by which the assessor may read the value of the ordinary corner lot simply by finding the ratio of the unit value of the front street to that of the side street and turning to the chart based on this ratio. Applying the lot dimensions to the chart, the value appears in the lower right hand corner. If the charts are based on a standard unit value of $1,000 for the principal street, the figure from the chart must be multiplied by the ratio of the actual unit value of the principal street to $1,000. The resulting product is the value of the corner lot. In the case of irregular lengths and breadths of lots and irregular ratios of unit values, interpolation in the tables will, of course, be necessary.

One of the puzzling questions is to derive a simple method of obtaining the value of a corner lot when the angle at the corner is other than 90 degrees. By reference to Figure 16, it is easily seen that the principle of valuation is not affected by differences in the corner angle. A change in this angle, however, will cause a shift in the position of the plane G W T D′ and hence readjustments in both primary and secondary values.

In most cities, practically all street intersections will occur at one of three or four different angles. It is perfectly feasible, therefore, to construct a separate set of charts for each of these important angles. By use of a few such charts, interpolation for lots of intermediate corner angles should be a fairly accurate method of valuation. For acute angles of 45 degrees or under, when one street has a decided preponderance in unit values, it will be approximately correct to add to the sum of the frontage strip values the primary value derived from the principal street covering the entire lot and the product of the co-efficient and the secondary value from the less important street also covering the entire area.

A series of depth value curves for various unit values plotted to scale on some transparent material will prove very

convenient for locating the point of intersection of the primary value planes from the different streets. By slipping one of these curves over the other in reverse directions, any point of intersection may be easily located.

By such devices, each assessor should be enabled to correctly value odd-shaped lots occurring in his district.

B. Wholesale and Manufacturing District

Much that has been said about the retail district holds true likewise for the wholesale and manufacturing districts but the problem is here considerably simplified. In this case, passers-by are not the main factor in value and usually their effect is entirely nil. Street frontage is valuable for the same reasons

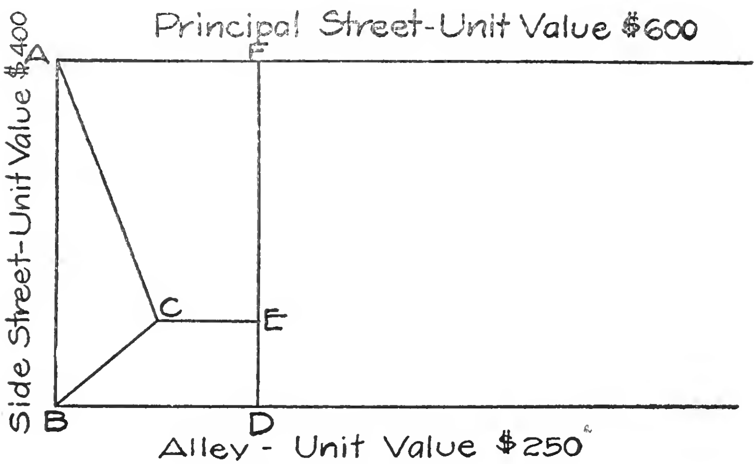

FIGURE 17.—CORNER-VALUATION—WHOLESALE DISTRICT

that alley frontage is valuable, simply because it furnishes light and air and means of access and transportation. There is no secondary value, the space utilized for the accommodation of customers being mainly located elsewhere than in the building. True, frontage on the street is usually somewhat more desirable than alley frontage because it furnishes a more favorable location for offices and frequently more room for loading and handling supplies but, in a general way, street and alley are similar. The frontage strip is utilized primar-

ily for access to light and air and not for show-window space, hence there is no enhancement in value at the corner. As a result, the value question is reduced simply to a question of intersection of depth curve surfaces. In an ordinary case, as shown by lot A B D F in Fig. 17, they might intersect along lines A C, B C, and C E. A series of diagrams could easily be constructed showing the lines of intersection for various ratios of unit values. In the case shown in Figure 17, triangle A B C would be valued as a lot facing the side street, trapezoid A C E F as a lot facing the principal street, and trapezoid B C E D as a lot facing the alley. The sum of the three values would be the value of the entire lot A B D F.

C. The Closely-Built Residence District

In the densely populated part of a city, residences are built so closely together that access to the street becomes of prime importance because of the necessity for light and air. The corner lot should be divided into two sections by the line along which the depth-curve surfaces from the two streets intersect. As stated previously, a chart may readily be prepared showing the line of intersection for each possible ratio of the unit values of the two streets. The resulting triangles or trapezoids should each be valued as a lot facing its respective street and the results summated—thus giving the value of the corner lot.

D. Suburban Residence Districts

In the outer residence districts, the houses usually do not cover a large fraction of the lot and light and air are, therefore, not at a great premium. The result is that a corner lot may be even less desirable than an inside lot especially if the side street is unimproved and a heavy paving tax is to be expected in the near future. At any rate, there is more sidewalk to build and keep clear of snow in the winter. These disadvantages are offset, and sometimes slightly overborne, by the better chance to display a fine residence and by the fact that the lot owner often has the use of the park space outside the walk. This park space is city property but is valuable to

the lot owner nevertheless. Despite the approximate equality of the foregoing advantages and disadvantages, a long corner lot usually brings a higher price in the market but principally for one reason only. This reason is that it affords opportunity for the building of additional houses on the rear part of the lot the houses being made to face the side street. In this way, more rentals may be secured and a greater surplus value above costs is received which naturally enhances the value of the land.

The following diagram illustrates the mode of taking account of corner influence in the case of an outside residence lot.

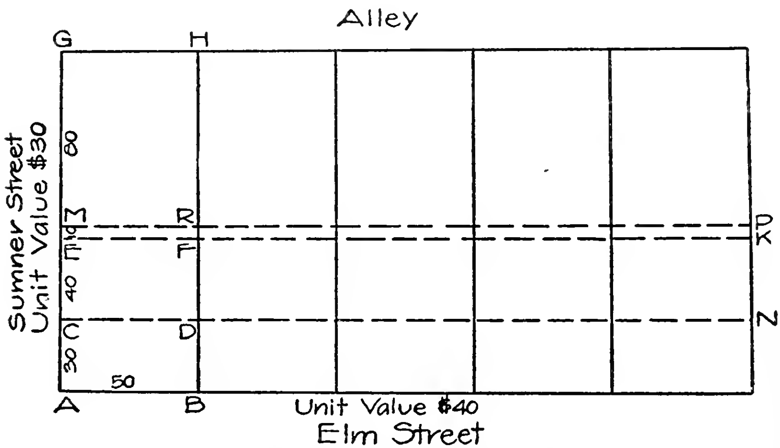

FIGURE 18.—CORNER INFLUENCE—SUBURBAN DISTRICT

If A B G H is a corner lot facing Elm Street with C N representing the alignment of the residence fronts, E K the approximate limit to which the buildings extend at the rear and M P a line parallel to E K and ten feet distant therefrom, then the area A B M R should be valued at the same figure as if it were an interior lot, of depth A M, facing Elm Street. The area G M H R, however, primarily derives its value not from Elm Street but from Sumner Street. It should, therefore, be treated as an interior lot, of depth M R, facing Sumner Street.

If A M = 80 feet,
A B = 50 feet.
G M = 80 feet,
Elm Street unit values = $40,
and Sumner Street unit values = $30,

the unit values being based on 100 feet in depth, and if, for lots 50 feet in depth, the percentage of the whole unit value is 72 and for lots 80 feet deep the percentage is 91, then the value of lot A B G H equals $.91 \times 50 \times 40 + 80 \times .71 \times 30$ dollars or $3548.

The reason for adding the strip M E F R to the lot facing Elm Street is that it is necessary to allow a few feet of space in order to give proper light and air for both buildings. In a suburban residence district, fifteen or twenty feet will probably be the customary distance and it seems fair to divide this space equally between the two parts of the lot. This division being made, the lot-value may be computed in the manner described above.

CONCLUSION

There has been no attempt made in this paper to deal exhaustively with the details of realty valuation but it is hoped that the fundamental principles here set forth will enable city tax departments and assessors to proceed with a little more ease and accuracy toward the establishment of scientfic and workable plans for valuing the real property which it is their duty to assess. Incidentally, some points in the problem of land valuation may be slightly clarified from the standpoint of economic theory. If either of these ends has been attained, this discussion of the matter is perhaps justified.

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